Chapter 5
IMPLEMENTATION STRATEGIES AND BASIS FOR RECOMMENDATIONS

INTRODUCTION

Chapter 5 identifies and provides key information about the projects and actions that will be undertaken to implement the *LEC Regional Water Supply Plan*. Specific recommendations are presented in Chapter 6. The first section of Chapter 5 provides an overview of regional water supply plan implementation strategies. It also provides definitions of water resource development and water supply development projects. The remaining two sections of this chapter present and discuss the water resource development projects and water supply development options proposed under this plan.

REGIONAL WATER SUPPLY PLAN IMPLEMENTATION STRATEGIES

Regional Water Supply Plan Implementation Assurances

Background

During the next 20 years, the SFWMD, the State of Florida, and consumptive users will be partners in implementing regional water supply plans (RWSPs) per a directive of state statute in Section 373.0361, F.S. The RWSPs provide a guide map for meeting consumptive user demands and natural system demands projected in 2020. There are economic, technical and political uncertainties associated with implementing water resource development projects of the complexity and scope recommended in the regional water supply plans. These uncertainties will be particularly evident during the interim period during which the various elements will be implemented and become operational. Reasonable certainty is needed for the protection of existing legal users and the water resources during the interim period.

Water resource development projects, operational changes, consumptive use permitting and rulemaking associated with the RWSPs are proposed to occur in phases. The increasing demands of consumptive users and the environment must, to the extent practicable, correspond with the timing of increased water availability. Where shifts from existing sources of water are required for environmental enhancement, it is crucial that replacement sources are available when such shifts occur.

Existing Florida law provides the framework and includes several tools to protect and maintain this phased or incremental consistency between increasing supplies and demands for both consumptive users and the environment. These include water reservations, consumptive use permits, minimum flows and levels recovery strategies, and

water shortage declarations. The framework for implementing these tools for resource restoration and protection from harm, significant harm and serious harm.

A composite schedule for implementation of these water resource tools in concert with water resource development projects will be proposed in the RWSPs. This schedule will be further refined during the five year water resource development work plan, five year water supply plan updates, annual budget reviews, periodic rule updates, and consumptive use permit renewals. Processes for contingency planning will also be developed to address uncertainties in the fulfillment of the water supply plans with the goal of complying with State requirements for the protection of existing legal users and environmental resources.

Water User and Natural System Assurances

Regional water supply plans (RWSPs) are developed and implemented pursuant to Chapter 373, F.S. Likewise, the level of assurances in protecting existing legal water users and the natural systems (assurances) while implementing the RWSPs must be consistent with this state law.

In this implementation process, the governing board will be faced with many policy decisions regarding the application and interpretation of the law. The unique legal, technical, economical and political implications of the RWSPs will all be considered in making these policy decisions. The District will be facing many of these issues for the first time in terms of their scale and significance.

The subject of assurances has been addressed in other forums, particularly in the Central and Southern Florida Project Comprehensive Review Study (Restudy) (April 1999), which was approved by the Governing Board. The language regarding assurances as incorporated into the Restudy was originally drafted by the Governor's Commission for a Sustainable South Florida and set forth in its final Restudy Plan Implementation Report (1999). This language is set forth below. Although these assurances were developed in the context of the Restudy implementation, such assurances are applicable to implementation of regional water supply plan recommendations under State law.

The Governing Board directs staff to implement the LEC Plan in accordance with the following assurances:

> C&SF Project Comprehensive Review Study, Volume 1, Section 10.2.9 (April 1999)
>
> 10.2.9. Assurances To Water Users
>
> The concept of “assurances” is key to the successful implementation of the Comprehensive Plan. Assurances can be defined in part as protecting, during the implementation phases of the Comprehensive Plan, the current level(s) of service for water supply and flood protection that exist within

the current applicable Florida permitting statutes. Assurances also involve protection of the natural system.

The current C&SF Project has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. Florida law requires that all reasonable beneficial water uses and natural system demands be met. However, the C&SF Project, or regional system, is just one source of water for south Florida to be used in concert with other traditional and alternative water supplies.

The Governor's Commission for a Sustainable South Florida developed a consensus-based set of recommendations concerning assurances to existing users, including the natural system (GCFSSF, 1999). The following text is taken from the Commission's Restudy Plan Report, which was adopted on January 20, 1999:

"Assurances are needed for existing legal users during the period of plan implementation. It is an important principle that has helped gain consensus for the Restudy that human users will not suffer from the environmental restoration provided by the Restudy. At the same time, assurances are needed that, once restored, South Florida's natural environment will not again be negatively impacted by water management activities. Getting 'from here to there' is a challenge. The implementation plan will be the key to assuring predictability and fairness in the process.

Protecting Current Levels of Service (Water Supply and Flood Protection) during the Transition from the Old to the New C&SF Project.

The goal of a sustainable South Florida is to have a healthy Everglades ecosystem that can coexist with a vibrant economy and quality communities. The current C&SF Project has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. In fact, if properly managed, enough water exists within the South Florida system to meet restoration and future water supply needs for the region. However, past water management activities in South Florida, geared predominantly toward satisfying urban and agricultural demands, have often ignored the many needs of the natural system (GCSSF, 1995; transmittal letter to Governor Chiles, p. 2). Specifically, water managers of the C&SF Project historically discharged vast amounts of water to tide to satisfy their mandate to provide flood protection for South Florida residents, oftentimes adversely impacting the region's estuarine communities.

The Commission recommended that in the Restudy, the SFWMD and the Corps should ensure that the redesign of the system allows for a resilient and healthy natural system (GCSSF, 1995; p. 51) and ensure an adequate water supply and flood protection for urban, natural, and agricultural needs (GCSSF, 1996a; p.14). In response to the need to restore South Florida's ecosystem, and in light of the expected future increase of urban

and agricultural water demands, the Restudy aims to capture a large percentage of water wasted to tide or lost through evapotranspiration for use by both the built and natural systems. In order to maximize water storage, the Restudy intends to use a variety of technologies located throughout the South Florida region so that no one single area bears a disproportionate share of the storage burden. This direction reinforces the Commission's recommendation that water storage must be achieved in all areas of the South Florida system using every practical option (GCSSF, 1996a; p. 25).

However, concerns have been expressed that a water user would be forced to rely on a new water storage technology before that technology is capable of fully providing a water supply source or that existing supplies would otherwise be transferred or limited, and that the user would thereby experience a loss of their current legal water supply level of service. Any widespread use of a new technology certainly has potential limitations; however, the Restudy should address technical uncertainties prior to project authorization and resolve them before implementation in the new C&SF Project. With the addition of increased water storage capabilities, water managers will likely shift many current water users to different water sources.

Additionally, stakeholders are concerned that a preservation of the current level of service for legal uses would not encompass all the urban uses, some of which are not incorporated in the term 'legal' and covered by permit. Specifically, an adequate water supply is needed to address urban environmental preservation efforts as well as water level maintenance to reduce the impact of salt water intrusion.

The Commission believes that in connection with the Restudy, the SFWMD should not transfer existing legal water users from their present sources of supply of water to alternative sources until the new sources can reliably supply the existing legal uses. The SFWMD should implement full use of the capabilities of the new sources, as they become available, while continuing to provide legal water users as needed from current sources. It is the Commission's intent that existing legal water users be protected from the potential loss of existing levels of service resulting from the implementation of the Restudy, to the extent permitted by law.

The Commission also recognizes that the SFWMD cannot transfer the Seminole Tribe of Florida from its current sources of water supply without first obtaining the Tribe's consent. This condition exists pursuant to the Seminole Tribe's Water Rights Compact, authorized by Federal (P.L. 100-228) and State Law (Section 285.165, F.S.).

However, the issues surrounding the development of specific assurances to water users are exceedingly complex and will require substantial additional effort to resolve.

RECOMMENDATION

The SFWMD and the Corps should work with all stakeholders to develop appropriate water user assurances to be incorporated as part of the Restudy authorizations. These water user assurances should be based on the following principles:

A. Physical or operational modifications to the C&SF Project by the federal government or the SFWMD will not interfere with existing legal uses and will not adversely impact existing levels of service for flood management or water use, consistent with State and federal law.

B.Environmental and other water supply initiatives contained in the Restudy shall be implemented through appropriate State (Chapter 373 F.S.) processes.

C.In its role as local sponsor for the Restudy, the SFWMD will comply with its responsibilities under State water law (Chapter 373 F.S.).

D. Existing Chapter 373 F.S. authority for the SFWMD to manage and protect the water resources shall be preserved.

Water Supply for Natural Systems

Concerns have been raised about long term protection of the Everglades ecosystem. According to WRDA 1996, the C&SF Project is to be rebuilt 'for the purpose of restoring, preserving, and protecting the South Florida ecosystem' and 'to provide for all the water-related needs of the region, including flood control, the enhancement of water supplies, and other objectives served by the C&SF Project.'

Environmental benefits achieved by the Restudy must not be lost to future water demands. When project implementation is complete, there must be ways to protect the natural environment so that the gains of the Restudy are not lost and the natural systems, on which South Florida depends, remain sustainable.

A proactive approach which includes early identification of future environmental water supplies and ways to protect those supplies under Chapter 373 F.S. will minimize future conflict. Reservations for protection of fish and wildlife or public health and safety can be adopted early in the process and conditioned on completion and testing of components to assure that replacement sources for existing users are on line and dependable. The SFWMD should use all available tools, consistent with Florida Statutes, to plan for a fair and predictable transition and long term protection of water resources for the natural and human systems.

Apart from the more general goals of the Restudy, there are specific expectations on the part of the joint sponsors - the State and the federal government. The more discussion that goes into an early agreement on

expected outcomes, the less conflict there will be throughout the project construction and operation.

RECOMMENDATIONS

The SFWMD should use the tools in Chapter 373 F.S. to protect water supplies necessary for a sustainable Everglades ecosystem. This should include early planning and adoption of reservations. These reservations for the natural system should be conditioned on providing a replacement water source for existing legal users which are consistent with the public interest. Such replacement sources should be determined to be on line and dependable before users are required to transfer.

The SFWMD should expeditiously develop a 'recovery plan' that identifies timely alternative water supply sources for existing legal water users. The recovery plan should consist of water supply sources that can reliably supply existing uses and whose development will not result in a loss of current levels of service, to the extent permitted by law. To assure that long term goals are met, the State and federal governments should agree on specific benefits to water users, including the natural system, that will be maintained during the recovery.

In the short term, the Restudy should minimize adverse effects of implementation on critical and/or imperiled habitats and populations of State and federally listed threatened and/or endangered species. In the long term, the Restudy should contribute to the recovery of threatened species and their habitats.

Protecting Urban Natural Systems and Water Levels

Water supply for the urban environment is connected to water supply for the Everglades and other natural areas targeted for restoration and preservation under the Restudy.

It is essential that the Restudy projects proposed to restore and preserve the environment of the Everglades do not reduce the availability of water to such an extent in urban areas that the maintenance of water levels and the preservation of natural areas becomes physically or economically infeasible.

The successful restoration of Everglades functions is dependent not only upon the establishment of correct hydropatterns within the remaining Everglades, but also upon the preservation and expansion of wetlands, including those within urban natural areas that once formed the eastern Everglades. Some of the westernmost of these areas have been incorporated in the Restudy as components of the WPAs. However, the on-going preservation efforts of local governments have acquired hundreds of millions of dollars worth of additional natural areas for protection both inside and outside of the WPA footprint.

Water supplies for these urban wetlands are not covered by existing permits or reservations and are therefore, not adequately protected. Efforts are underway at both the SFWMD and the local level to preserve these vital areas and assure their continuing function as natural areas and in ecosystem restoration.

Detailed design for the Restudy, in particular the detailed modeling associated with the WPA Feasibility Study, will make possible plans to protect these urban wetlands from damage and to assure maximum integration with Restudy components.

RECOMMENDATIONS

The SFWMD and the Corps should acknowledge the important role of urban natural areas as an integral part in the restoration of a functional Everglades system. As a part of the implementation plan, the SFWMD and the Corps should develop an assurance methodology in conjunction with the detailed design and modeling processes, such as the WPA Feasibility Study, to provide the availability of a water supply adequate for urban natural systems and water level maintenance during both implementation and long term operations.

Expand and accelerate implementation of the WPAs. Accelerate the acquisition of all lands within the WPA footprint to restore hydrologic functions in the Everglades ecosystem, and ensure hydrologic connectivity within the WPA footprint. The WPA Feasibility Study process should be given a high priority. The WPA concept should be expanded into other SFWMD planning areas such as the Upper East Coast.

The Restudy should assure that the ecological functions of the Pennsuco wetlands are preserved and enhanced."

There is a substantial body of law that relates to the operation of Federal flood control projects, both at the state and Federal level. Much of the Governor's Commission language is directed to the South Florida Water Management District and matters of state law. To the extent that the Governor's Commission's guidance applies to the Corps' actions, the Corps will give it the highest consideration as Restudy planning proceeds and as plan components are constructed and brought on-line consistent with state and Federal law. The recommended Comprehensive Plan does not address or recommend the creation or restriction of new legal entitlements to water supplies or flood control benefits.

Regulatory Implementation

Introduction

The purpose of this discussion is to outline the relationship and distinction between the planning process and the regulatory implementation of the *LEC Regional Water Supply Plan*. In order to understand how these two water management components work together, it is helpful to know the limits and scope of each.

This section describes the planning level vision of the regulatory component. It is essential that the regulatory component described below be viewed as a flexible framework for implementing actions. During development of the rules and other agency actions necessary to implement the regulatory component, public input and governing board direction will be incorporated to further refine this framework

The water supply plan contains descriptions of structural, regulatory and operational elements, along with procedures by which the elements will be implemented. Planning evaluations are conducted with a set of assumptions and approximations that may change over time with variations in social and economic factors in the economy of the region. While a plan does evaluate cumulative impacts of existing and potential water withdrawals, the plan is not a master permit, nor does it pre-determine decisions to be made in the permit review process.

The relatively local variations occurring on a project by project basis are not anticipated to have regional, or otherwise significant, implications on the implementation of the regional water supply plan objectives. In order to address the local and regional impacts of water uses on a day to day basis, the District utilizes its statutory authorities in regulating the consumptive use of water. When used in conjunction with a regional water supply plan, the CUP regulatory process is able to prevent over allocation of regional and localized water resources and to assure a level of certainty for permitted users, exempt users and the environment.

The LECRWSP contains projections for both the water supply and demand estimates over the next twenty years and timeframes for expansion of water supplies to meet environmental and man's needs. In addition, protocols for the delivery of water to the natural system and consumptive uses have also been evaluated in the plan. In order to ensure water supplies are used for their intended purposes, or to protect against water supplies being “taken away” from such intended uses, the District will use its regulatory authority to implement water shortage cutbacks during drought, reserve water from CUP allocation for the natural system and public health and safety, and protect water supplies designated for permit holders.

In order to achieve the regulatory goals of the water supply plan, the District will develop rules and implement the rules consistent with state law. However, this raises a question: If the rule development and implementation process is separate from the plan, how can the public be assured the resulting rules will be consistent with the plan? This assurance is provided through the administrative procedures outlined in state law under

Chapter 120, F.S. Both rulemaking and formal agency actions of the District must comply with requirements affording substantially affected parties the opportunity to participate in the rule development process and to challenge proposed rules, existing rules, and final and proposed agency action.

Should the rulemaking deviate from performance measures used in the plan, the Governing Board may direct staff to conduct additional evaluations to supplement the planning level evaluations to support the proposed rule, or revise the rule draft consistent with the planned performance measures. In addition, opportunities for LEC member involvement in identifying contingency actions necessary to implement additional water resource development projects in light of the proposed rules are outlined in the section on "Contingency Planning," at the end of this chapter.

It has been determined that the existing plumbing system used to deliver water throughout the region presents significant constraints on environmental restoration. As a result, significant structural changes, to be completed over time, are necessary to achieve restored hydropatterns for regional natural systems. Therefore, the amounts of water to be delivered and protected and the timing and sources of supply to be incorporated under a reservation rules, and other resource protection standards described below, will evolve with the implementation of water resource development projects. Florida law is well suited to deal with the situation in south Florida where the water supply picture will be changing significantly with the development of water resource projects outlined in the CERP and LEC plans.

The need for flexibility in implementing a phased restoration project raises a question: what assurances are there that the future water supply identified environmental water supplies, including reservation, will not be permitted away? Several factors associated with the implementation of this plan address this concern.

First, the plan includes water resource development projects that provide adequate supplies of water through a 1 in 10 year drought condition, to meet the needs of the environmental restoration and permitted water uses by 2020. A "have and have not" situation does not occur under this plan and the environment and CUPs do not need to compete.

Secondly, the proposed CUP rules contain provisions to limit new demands on the regional system as the water resource development/CERP projects are being constructed. These include limiting the amounts of regional water that can be allocated to each service area in five year increments based on the results of the planning analysis. If cumulative regulatory evaluations indicate that the five year limitations on regional water allocations have been reached, new or increased demands will be met through alternative (non-regional) supplies until additional water is available. Also, existing supplies can be more efficiently utilized to meet increasing demands, until additional regional supplies are made available. As part of this process, it is envisioned that both CUP water supplies and environmental water reservations will be updated every five years as necessary to reflect the changed water supply availability picture as the projects associated with this plan are completed.

Should the water supply needs of the natural system or consumptive uses exceed the projections in the RWSP, the District will utilize the planning process to identify and develop alternative water resource development projects to avoid competition to the greatest degree possible. “Assurances” set forth in this plan and the contingency planning process will be applied to protect consumptive uses and the natural system during this process.

The following sections give a brief overview of the legal and policy issues associated with the major tools for implementing the regulatory component of the regional water supply plan, discussed above. This discussion should be read in context of the LECRWSP as a whole, and is not intended to be inclusive of all of the relevant legal and policy factors considered in development of the plan.

Water Reservations

Legal Description:

Section 373.223(4) authorizes water management districts to reserve a quantity of water for the protection of fish and wildlife or public health and safety. Section 373.223(4), F.S., provides, in relevant part:

> The governing board or the department, by regulation, may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgment may be required for the protection of fish and wildlife or the public health and safety.

The statute also provides that reservations are subject to periodic review based on changed conditions. This provides flexibility to account for changes in implementation strategies and contingency plans during the next 20 years. A specific level of protection is also provided to existing legal users when establishing reservations. Existing legal users are protected insofar as they are “not contrary to the public interest.” Section 373.223(4), F.S.

Reservation Implementation Policies:

Reservations will reflect environmental enhancement and protection goals and objectives consistent with the Restudy hydropattern achievable by 2020, based on the degree of CERP implementation expected within that time frame. When appropriate, rainfall driven formulas will be used determine reservation quantities. Reservations will incrementally delineate and protect the volume and timing of necessary environmental water supply deliveries during hydrologic conditions up to and including a 1 in 10 year drought event. Likewise, consumptive use demands under conditions up to and including a 1 in 10 year drought event are estimated and will be incrementally protected through consumptive use permits. Water shortage provisions (see below) will govern the actions of the water management district in providing shared adversity to both the natural system under rainfall driven formulas and consumptive users for conditions beyond the 1 in 10 level of drought.

Water availability for environmental purposes and the ability to deliver the water will increase as water resource development projects come "on line." Initial and incremental increases in water reservations to meet increased water deliveries to the natural system shall be contingent upon availability of water from water resource development projects provided to augment or create supplies to meet such demands.

The reservation rule will include a description of the ultimate 2020 restoration deliveries to the natural system. The rule will also will account for potential changes to reflect refinement of the project designs or restoration targets. The rule will incorporate the list and description of the water resource development projects and amounts of water potentially to be made available for the reservation upon deployment. Finally, the rule will include water supply formula and protocols to define the amount and timing of water supply deliveries based on the remaining constraints on the regional system. As new water resource development projects are brought on line, the rule will be revised to include the resulting improvements in deliveries. A series of water resource development projects are identified on **Table 46** that will provide water to meet MFL targets and reservations. The anticipated completion date of each of these options are also included.

Initially (2000,2001), water reservations rules will be drafted for the ENP and WCAs. Additional reservation rules for the other listed water bodies will be undertaken as supporting technical research is concluded and water supplies to meet the natural system demands are made available. The dates shown in the table represent when revisions to the reservation rules are expected. See Composite Schedule.

The District will identify water bodies that will be targeted for reservation in the LECRWSP. The District will establish reservations by rule through a public review process with the initial reservation rules targeted for completion by 2001.

Consumptive Use Permitting

Legal Description

Under Section 373.219, F.S., the yield of the source, or amount of water which can be permitted for use, is limited, in part, by the resource protection criteria which defines when "harm" will occur to the resource. Resource protection criteria has been adopted by the water management districts under the three prong test in Section 373.223, F.S.Under this three prong test, all consumptive uses must be reasonable-beneficial, consistent with the public interest, and not interfere with other presently existing legal uses. The reasonable beneficial use test is aimed at preventing saltwater intrusion and saline water upconing, harm to wetlands and other surface waters, aquifer mining and pollution. In addition, the reasonable-beneficial use test requires consumptive uses to be efficient and consistent with the public interest.

Harm in the resource protection framework proposed in this plan is the extent of adverse impacts that requires one to two years of average rainfall to recover. Harm for purposes of allocating water is considered to occur in this document to be the point at which adverse impacts to water resources that occur during dry conditions are sufficiently

Table 46. Water Resource Development Projects that Provide Water Supplies Associated with MFL Recovery Plan and Water Reservations

Water Body	Basis of Reservations	WS Projects Providing Supply for Reservations	Five Year Update when Project Would First Be Completed
ENP	Rainfall driven/ Stage formula	ECP	2005
		MOD Water	2005
		C-111	2005
		L-31 Seepage Management w/o barrier	2010
		WCA-3A, 3B Seepage Management	2010
		WCA 3A Decampments Phase I	2010
		WCA-3A Decampments Phase II	2020
		Miami/Dade Reuse 50 mgd	2020
		Lake Belt Central 92,160 acre ft	2020
Glades WCA/ENP	Rainfall driven/ Stage formula	EAA Reservoir (160,000 acre ft.)	2010
		EAA Storage North (120,000 acre ft)	2010
		EAA Storage South (60,000 acre ft.)	2015
		Taylor Creek Reservoir (50,000 acre ft)	2010
		Lake Okeechobee ASR 500 mgd	2015
		Lake Okeechobee ASR 1000 mgd	2020
		North Lake Okeechobee Reservoir	2015
St. Lucie Estuary	Salinity envelope criteria	C-44 Reservoir (30,000 acre ft)	2010
Caloosahatchee Estuary	Salinity envelope criteria	C-43 reservoir	2010
		C-43 ASR (220 mgd)	2015
STAs *	6 inch min depth	Lake Okeechobee Storage	2005
Loxahatchee River	Salinity envelope criteria	Southern L8 Reservoir	2015
		WPB Water Catchment Area ASR	2015
Biscayne Bay Florida Bay	Salinity envelope criteria	Degrade L-29 New S-336B New S-338	2010
		Miami-Dade Reuse South (131 mgd)	2020
		Lake Belt Central 92,160 acre ft	2020
		Lake Belt North 45,000 acre ft	2020
* MFL not applicable to this water body.			

severe that they cannot be restored within a period of one to two years of average rainfall conditions. These short-term adverse impacts will be addressed under the consumptive use permit program, which calculates allocations to meet demands for use during relatively mild, dry season conditions. The harm criteria will be met for hydrologic conditions through a 1 in 10 year drought event and permitted allocations will be based on demands up to and including the 1 in 10 level of certainty.

CUP Implementation Policies

The following excerpts from Chapter 373 provide the basic level of protection given to existing legal users under the law:

> "The SFWMD and the State will act with a view to full protection of the existing rights to water insofar as is consistent with the purposes of Chapter 373, F.S. (s. 373.171(1)(b)).
>
> "No rule or order shall require any modification of existing use or disposition of water in the District unless it is shown that the use or disposition proposed to be modified is detrimental to other water users or to the water resources of the state." S. 373.171(2), F.S.

Projects for obtaining water supply benefits for consumptive uses shall be prioritized to first maintain existing reasonable-beneficial water demands with a 1 in 10 year level of certainty, and then to meet increasing demands.

Water supplies necessary to meet increasing reasonable-beneficial demands will be contingent upon the demonstrated availability of the water resources to supply required volumes, the performance of water resource development projects identified to augment or create supplies to meet such demands, and the applicant's water supply development strategy for meeting the specified demands. Water availability for future permit allocation will be defined by many factors, including the:

- Extent to which the resource has been successfully used by the applicant in the past.
- Extent to which the particular source is expected to be developed for use and the timing of such demand increases.
- The extent to which the water supply source derives water from the regional system versus local storage.
- Extent to which the source is being diverted for non-consumptive uses (e.g., reservations), and the timing of such diversions.
- Extent to which a particular use was considered in the regional water supply plan process, and the short term and long term demand projections for such use.
- Identified water resource development projects and timing of implementation.

Once the 1 in 10 level of certainty criteria is established by rule, permits will be issued based on the applicant's ability to provide reasonable assurances of both reasonable demand and protection of water resources and not interfere with existing legal users. For existing projects that have been operational during a 1 in 10 year drought without water resource harm or existing legal user interference, the historical performance of the project will be considered in providing reasonable assurances that the conditions for permit issuance are met upon permit renewal.

Implementation of Minimum Flow and Level Recovery and Prevention Strategies

Legal Description

Minimum flows and levels are established pursuant to Section 373.042, F.S. A detailed description of the process and factors for establishing MFLs is included in the document entitled "Minimum Flows and Levels for the Everglades, Biscayne Aquifer and Lake Okeechobee."

Section 373.0421, F.S. requires that once the MFL technical criteria have been established, the Districts must develop a recovery and prevention strategy for those water bodies that are expected to exceed the proposed criteria. In devising an MFL recovery strategy, the District will recognize statutory direction to achieve recovery *as soon as practicable*, pursuant to Section 373.0421, F.S. In addition, Section 373.0421 provides in relevant part:

> "The recovery or prevention strategy shall include phasing or a timetable which will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures concurrent with to the extent practical, and to offset, reductions in permitted withdrawals, consistent with the provisions of this chapter." Section 373.0421(2), F.S.

MFL Strategy Implementation Policies

It is possible that the proposed MFL criteria cannot be achieved immediately because of the lack of adequate regional storage and/or ineffective water distribution infrastructure. These storage and infrastructure shortfalls will be resolved through water resource development and water supply development projects, construction of facilities and improved operational strategies that will increase the region's storage capacity and improve the existing delivery system. Planning and regulatory efforts will, therefore, include a programmed recovery process that will be implemented over time to improve water supply and distribution to protect water resources and functions.

Where structural solutions are necessary, the recovery/prevention plan will include a list of projects and timing and funding. The funding and construction priorities for the reduction of MFL exceedences as soon as practicable must be identified.

Demand management cutbacks for recovery during drought conditions will also be identified if necessary to prevent MFL exceedances, e.g., phased water shortage restrictions to prevent significant or serious harm.

To the extent practicable, the District shall implement water deliveries to reduce or prevent MFL violations. Operational guidelines necessary for implementation of water supply deliveries to achieve MFLs, in concert with meeting other required water demands,

will be identified. However, water deliveries to prevent MFL violations will be given priority consideration over deliveries for other water resource protection purposes.

Before considering reduction in permitted withdrawals in a recovery and prevention strategy, all practical means to prevent reductions in available water supplies for consumptive use shall be explored and implemented. When determining whether reductions in existing legal uses is required, the following factors shall be considered:

- Extent of MFL shortfall directly caused by existing legal uses.
- Available practical measures to avoid reductions in permitted supplies, including structural and operational measures to maximize the beneficial use of the existing water source.
- The risk of significant harm resulting from the existing legal use in the interim period before the recovery strategy is fully implemented. This evaluation will consider the length of time before shortfalls will be met through the recovery and prevention strategy.

Water Shortage Implementation

Legal Description

Pursuant to Section 373.246, F.S., water shortage declarations are designed to prevent serious harm from occurring to water resources. Serious harm, the most severe level of harm to the water resources contemplated under Chapter 373, F.S., can be interpreted as long-term, irreversible, or permanent adverse impacts. The District will develop and adopt water shortage triggers to avoid causing harm, significant harm and serious harm to water resources, in conjunction with the implementation of the District's Water Shortage Plan (Chapter 40E-21, F.A.C.). Water resource "triggers" will be identified for the imposition of water shortage restrictions, considering on climactic events, continued decline in water levels and a need to curtail human demand to correspond to decreasing supplies. These restrictions act to apportion among uses, including the environment, a shared adversity resulting from a drought event. Adoption of the resource protection criteria as water shortage trigger indicators also serves the purpose of notifying users of the risks of water shortage restrictions and potential for loss associated with these restrictions.

Water Shortage Implementation Policies

Shared adversity between natural systems and consumptive use withdrawals will be experienced ~~achieved~~ through implementation of water shortage measures. When evaluating options to obtain a shared adversity for users and the natural system during droughts, the District will consider the extent to which consumptive use withdrawals influence water levels in the natural system and the extent to which natural system water levels are deviating from rainfall driven formula targets for the associated level of

drought. Adversity to existing legal users is measured in terms of projected economic losses.

Water supply demands defined by rainfall driven formulas, naturally decrease with increased drought levels, while consumptive use demands increase. For this reason, water delivery cutbacks to the natural systems during droughts should not be necessary. An exception to this could occur if the delivery of rainfall based supplies causes greater environmental harm elsewhere in the natural system. Under this scenario, the governing board, after considering all of the specific facts, and in consultation with the public, may order temporary reductions in natural system deliveries in order to protect more vulnerable portions of the natural system from further harm.

Even though water shortage triggers have been established in the modelling assumptions in the LECWSP, actual water restrictions will be determined on a case-by-case analysis for a given drought event. Thus, prior to declaring a water shortage, the District will also analyze the factors listed in the Water Shortage Plan concerning such issues as: (1) whether or not sufficient water will be available to meet the estimated and anticipated user demands; and, (2) whether serious harm to the water resource will occur.

Contingency Planning

The timing of physical, regulatory or operational modifications required to implement the regional water supply plan will be coordinated, to the extent practicable, to avoid reductions in water supplies for environmental restoration and consumptive use demands. If, however, practicable measures are not available, the District will provide a contingency plan that is designed to maintain a shared optimization in the use of available water supplies, until the long term source augmentation is implemented.

Regional water supply plans will be updated at least every five years, as required by law. If significant changes in planning assumptions occur during the five year intervals and require the plan to be revisited, updates will occur, as appropriate, more often than the five year scheduled update. This determination by the governing board will be, in part, based on annual status updates to the DEP and the legislature and CERP annual status updates. Updates on progress on the implementation of CERP projects and their expected performance will be presented to the LEC Committee by representatives from the CERP teams. These presentations will include updates on relevant PIRs and feasibility studies as well as the RECOVER process. If the determination is made that contingencies need to be implemented, the process to accommodate these changes include quarterly meeting of the LEC advisory committee and redirection of staff and resources through the five year resource development work plans and the annual budget process.

The district will establish a process for identifying opportunities to provide water supply benefits to natural systems on an annual or seasonal basis when unaccounted for or surplus water supplies exist, after considering the permitted demands of consumptive uses. Opportunities to deliver such water supplies through operational flexibility will be examined and implemented, after consideration by the governing board, as appropriate. See operational flexibility recommendations in Chapter 6.

Statutory Definition of Water Resource development and water supply development

The projects and actions proposed for implementation are discussed in two categories, water resource development projects and water supply development options.

This is in concert with amendments to Chapter 373, F.S. that were passed in 1997, which require that water supply plans include a water resource development component and a list or menu of water source options for water supply development that can be chosen by local water users. The statute defines water resource development and water supply development as follows:

> 'Water resource development' means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water data; structural and nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

and,

> 'Water supply development' means the planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use.

Structural and non-structural water resource development components are identified below. These include actions necessary to implement the RWSP, including minimum flows and levels recovery and prevention strategy, water reservations, water shortage provisions, operational strategies and contingency planning.

Chapter 373, F.S. requires that water supply plans include a list or menu of water source options for water supply development that can be chosen by local water users. For each source option listed, the estimated amount of water available for use, cost, potential sources of funding, and a list of water supply development projects that meet applicable funding criteria are required. In addition, water supply plans must also include a list of water resource development projects that support water supply development. For each water resource development project, estimates of the amount of water produced, timetables, funding requirements, and participants who will implement the project must also be provided.

In the LECRWSP the SFWMD is primarily responsible for the implementation of the water resource development component. Local users have primary responsibility for

water supply development by choosing the water source options will best meet their needs.

In addition to the legislative definitions described above, the designation of a project as a water resource development project was be based on consideration of the following characteristics:

- Opportunity to address more than one resource issue
- Address a variety of use classes (e.g., environment, public water supply)
- Protect/enhance resource availability for allocation
- Move water from water surplus areas to deficit areas
- Broad application of technology (“broad-reaching”).

The equivalent characteristics that led to designations of projects as water supply development projects are:

- Localized implementation of technology
- Delivery of resource to consumer
- “Regionalized” interconnects to consumer

WATER RESOURCE DEVELOPMENT COMPONENTS

Water Resource Development Components to be implemented as part of this Plan are discussed in this section. They have been divided into and are discussed below under the following categories:

- Interim Plan Projects,
- Other Federal, State, or District Projects,
- Comprehensive Everglades Restoration Plan,
- Guidance to CERP from the LEC Plan,
- Guidance to CERP from the Caloosahatchee Water Management Plan
- Operational Strategies,
- Consumptive Use Permitting and Resource Protection and
- Other Water Resource Projects

Interim Plan Projects

The first set of water resource development projects are those that were recommended in the Interim Plan (March 1998), have not yet been completed and are judged appropriate for continued effort. Information regarding each of these projects is

briefly discussed in **Table 47** below, which also identifies the numbered recommendation in Chapter 6 to which each corresponds..,

Other Federal, State, and South Florida Water Management District Projects

Two groups of projects have been included in this category. The first includes those critical projects in the LEC Planning Area for which the SFWMD is local sponsor. The critical project program was authorized by congress under the Water Resources Development Act of 1996 to expeditiously implement restoration projects that are deemed critical to the restoration of the South Florida ecosystem. The federal participation in critical projects is for 50% of total project costs, with a maximum federal contribution on any project of $25,000,000. The three critical projects included here are the Western Canal Structure (C-4), the Western C-11 Water Treatment Project and the Lake Okeechobee Water Retention/Phosphorus Removal Project. They are covered under Recommendation 13 in Chapter 6. The second group are District initiated projects and include three projects that reflect recommendations developed in the Caloosahatchee Water Management Plan and a recommendation regarding Mobile Irrigation Labs. Each of these projects is discussed below.

West Canal Structure (C-4) (Recommendation 13, Part)

This project is being implemented as a critical project and is part of the without plan condition for the LEC Plan. It consists of a new structure in the C-4 Canal, immediately southeast of the Pennsuco Wetlands. It will keep higher surface and ground water levels to the west, which will reduce drainage from the Pennsuco Wetlands and the Everglades and help reestablish natural hydroperiods in these areas.

Western C-11 Water Treatment (Recommendation 13, Part)

This project is being implemented as a critical project and is part of the without plan condition for the LEC Plan. The purpose is to improve the quality and timing of discharges to the Everglades from the Western C-11 Basin. A gated control structure on the C-11 Canal will be used to keep clean seepage water from mixing with lower quality runoff water from the Basin. An additional pump station will be completed so the seepage water can be returned to the Everglades Protection Area.

Lake Okeechobee Water Retention/Phosphorus Removal (Recommendation 13, Part)

This critical project will restore the hydrology of wetlands in four key basins north of Lake Okeechobee using two approaches. First, it will plug drainage ditches that connect wetlands to canals to drain land to create improved pasture. This will help retain water in the wetlands and improve water quality treatment functions of the wetlands. Second, it will divert canal flows into adjacent wetlands, which will also attenuate flows and retain phosphorus.

Table 47. Summary Information Regarding Water Resource Development Recommendations from the Interim Plan.

Rec. No.	Water Resource Development Project	Location in the Interim Plan	Progress to Date	Need for Continued Effort
1	Regional Salt Water Intrusion Monitoring – Biscayne Aquifer	21 - 22	Additional wells have been installed in Miami-Dade, Broward, and Palm Beach counties.	Gaps remain in the monitoring network and research and modeling need to be undertaken to better define the relationships between water levels and saltwater migration..
2	Floridan Aquifer System Modeling	23 - 24	Initial model was developed.	A need has beenidentified for more data to augment and refine the model and better assist with planning and regulatory decision making.
3	Northern Palm Beach County Comprehensive Water Management Plan	35 - 36 and 37 - 39	Plan is almost complete and conceptual designs have been largely incorporated into the Restudy and the LEC Regional Water Supply Plan.	Plan will be completed in the summer of 2000 and implemented through the CERP and the LEC Regional Water Supply Plan.
4	Eastern Hillsboro Regional ASR Pilot Project	47 - 49	Biscayne wells to support the first ASR well are under construction.	The initial Floridan ASR well needs to be completed, its performance evaluated, and a decision made regarding completion of a second ASR well.
5	Southeastern Palm Beach County Storage Feasibility Analysis	45-46	The proposed Hillsboro reservoir has been incorporated into CERP	The pilot project will proceed in advance of the CERP project. A small-scale reservoir will be constructed and seepage rates and collection systems evaluated.
6	Lake Worth Lagoon Minimum/ Maximum Flow Targets	109 - 111	A preliminary hydrodynamic model has been completed.	Additional tidal amplitude and salinity data for dry and wet periods needs to be collected. The effort will cover a larger area and be completed for shorter time steps than the original effort. The model needs to be updated and extended using these data. Evaluations need to be run to determine the impacts of inflows on biological (sea-grass) communities.
7	Northeastern Broward County Secondary Canals Recharge Network	63 - 64	Three projects (two pump stations and one canal connector) have been funded.	The remainder of the network needs to be designed and constructed.
8	Southeastern Broward County Interconnected Water Supply (Utility Supply Options)	65 - 66	Facilitated sessions to achieve agreement on an integrated water supply system for Southeastern Broward County are under way.	A final agreement acceptable to all parties needs to be developed and implemented.
9	Broward County Urban Environmental Enhancement (outcome of Broward County Integrated Water Resource Plan)	59 - 61	The recommendation to evaluate sources and methods to use surface water to benefit wetlands in coastal Broward County was developed through the Broward County Integrated Water Supply Plan.	This project proposes to implement the recommendation by first identifying wetland systems with needs and then evaluating the advisability of structural and regulatory programs to support the proposed environmental enhancements.
10	Utility ASR for Miami-Dade Water and Sewer Department	79 - 80	Some of the ASR wells have been built and they are undergoing testing.	Remaining proposed wells need to be constructed.

Table 47. Summary Information Regarding Water Resource Development Recommendations from the Interim Plan.

Rec. No.	Water Resource Development Project	Location in the Interim Plan	Progress to Date	Need for Continued Effort
11	Biscayne Bay Minimum/ Maximum Flow Targets	113 - 114	USACE, as part of the Biscayne Bay Feasibility Study, has developed and is validating a hydrodynamic model. The model is a key tool in determining these target The USGS completed a regional ground water model. Ecological response evaluation tools may need to be developed.	To complete this work, additional hydrologic data needs to be collected, performance measures determined, and scenarios run and evaluated in terms of the ecological responses. Work will needed to be completed in close cooperation with CERP monitoring and evaluation efforts (RECOVER).
12	Seminole and Miccosukee Tribes	85-87	The Water Rights Compact was entered into in 1987, and protects the Tribes water rights and development potential. Implementing agreements and District Orders have been entered into in furtherance of the Compact. To date, no comparable mechanism exists to recognize the water rights of the Miccosukee Tribe of Indians	This reiterates that the LEC Plan recommendations do not modify the District's or SeminleTribe's rights as established in the Compact or subsequent implementing agreements and orders. A mechanism for recognition of Miccosukee Tribe water rights needs to be established.

Because it was not certain that this project would be implemented as a critical project, costs to complete this work were included as part of the larger Lake Okeechobee Water Quality Treatment Facility project which is part of the Comprehensive Everglades Restoration Program (CERP) discussed below.

Well Abandonment Program in the Caloosahatchee Basin (Recommendation 14)

The Caloosahatchee Water Management Plan (CWMP) has identified a problem with free-flowing brackish aquifer wells that was not adequately addressed by the Well Abandonment Program that was administered by the SFWMD and ended in 1991. In the CWMP it is recommended that additional efforts should be made to locate and properly abandon the free flowing wells in the Caloosahatchee Basin. It is further recommended that the SFWMD should work with local and state officials to locate uncontrolled abandoned wells and identify plugging strategies and applicable funding sources for proper plugging of the wells.

Saltwater Influence in the Caloosahatchee River (Recommendation 15)

The need for this project was identified in the Caloosahatchee Water Management Plan (CWMP). Historically, saline water (in excess of 250 milligrams per liter [mg/l]) has been a recurring problem during extended periods of low-flow for the potable water intakes in the Caloosahatchee River, which are located approximately one-mile upstream of S-79. While, freshwater releases for environmental purposes may minimize

occurrences of this problem in the future, a number of alternatives warrant further investigation. They include moving the intakes farther upstream, modifications to the structure, limiting lockages during low flow periods, and improved maintenance and operation of the bubble curtain. The proposed project would conduct additional analyses of the saline water problem and potential solutions.

Permitting Issues Associated with ASRs (Recommendation 16)

Both the CERP and the LEC Plan recognize that the SFWMD will need to continue working with the legislature, FDEP and the federal EPA to develop rules and permitting procedures that will facilitate development of ASRs systems while providing appropriate protection for potential users. This project provides for staff participation to handle LEC Plan implementation issues that arise as part of this larger process.

Mobile Irrigation Labs (Recommendation 17)

This recommendation continues support for Mobile Irrigation Labs as an effective conservation support program. However, recent decisions by the Governing Board related to CERP funding have indicated that this is not a core program for funding by the SFWMD. As a result SFWMD participation in funding will be limited to providing staff to garner support form other agencies such as DEP, DACS and Soil and Water Conservation Districts as well as users.

Comprehensive Everglades Restoration Plan (CERP) (Recommendation 18)

The LEC Plan is in a unique situation in that the SFWMD has just recently completed with the U.S. Army Corps of Engineers a complete reevaluation of the C&SF Project. This effort was called the “Restudy” and the recommended plan is contained in the Central and Southern Florida Project Comprehensive Review Study Report dated April 1999. The implementation effort based on this report is call the Comprehensive Everglades Restoration Plan (CERP).

The recommended plan includes components that will change the functioning of this already extensive system to meet ecosystem restoration and improvement goals and provide the regional system capabilities, including water resource development capabilities, needed to meet urban and agricultural water demands through 2050. Many of these water resource development projects had been evaluated in the initial LEC planning process and provided to the Restudy for further evaluation.

Thus, when looking at alternatives beyond the 2020 base case, the *LEC Regional Water Supply Plan* included the planned implementation of the CERP. In the simulation of the alternatives, the initial alternative incorporated the CERP components and was called the “LEC 2020 with Restudy.” The other alternative, LEC-1, also included the CERP components. One of the goals of the alternatives’ evaluations was to determine the extent to which the expected CERP projects will provide the water resource development needed

to meet the goals of the *LEC Regional Water Supply Plan*. The conclusion reached in Chapter 4 was that the CERP projects scheduled to be completed by 2020, along with wellfield development assumptions, provides the needed water resource development to achieve the *LEC Regional Water Supply Plan* planning goal of providing users with a 1-in-10 level of service. Thus, implementation of CERP becomes the lynchpin of the water resource development actions proposed by the *LEC Regional Water Supply Plan*.

CERP will be implemented by a joint federal/state/District process. The role of the LEC Plan is to recognize the contributions of CERP toward meeting its goals and to advise CERP of its findings and their implications for CERP planning and implementation efforts. These are considerations that could further improve the CERP performance and cost-effectiveness that have been discovered through the *LEC Regional Water Supply Plan* modeling and evaluations.

Since CERP is the major water resource development component of the LEC Plan, this report contains a summary documentation of the CERP Recommended Comprehensive Plan. More complete documentation is available in the Central and Southern Florida Project Comprehensive Review Study Report dated April, 1999 which is available from the U.S. Army Corps of Engineers in printed form or on CD-ROM. The report, evaluations and other documentation of the Restudy Planning process and CERP implementation process are provided at the CERP web site at http://www.evergladesplan.org/. The summary documentation presented below is taken from the Summary of the Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, pages vii to xiii of Volume 1.

> Major Features of the Recommended Comprehensive Plan
>
> The Restudy Team formulated and evaluated 10 alternative comprehensive plans and more than 25 intermediate computer simulations. Alternative D-13R was selected as the Initial Draft Plan. Alternative D-13R along with the series of Other Project Elements, Critical Projects, water quality treatment facilities, and other modifications that further improve performance of the plan, comprise the recommended Comprehensive Plan. The estimated first cost of the recommended Comprehensive Plan is $7.8 billion; and the annual operation and maintenance costs, including adaptive assessment and monitoring, are $182 million. The plan includes the following structural and operational changes to the existing C&SF Project:
>
> **Surface Water Storage Reservoirs.** A number of water storage facilities are planned north of Lake Okeechobee, in the Caloosahatchee and St. Lucie basins, in the Everglades Agricultural Area, and in the Water Preserve Areas of Palm Beach, Broward and Miami-Dade counties. These areas will encompass approximately 181,300 acres and will have the capacity to store 1.5 million acre-feet of water.
>
> **Water Preserve Areas.** Multipurpose water management areas are planned in Palm Beach, Broward and Miami-Dade counties between the

urban areas and the eastern Everglades. The Water Preserve Areas will have the ability to treat urban runoff, store water, reduce seepage, and improve existing wetland areas.

Manage Lake Okeechobee as an Ecological Resource. Lake Okeechobee is currently managed for many, often conflicting, uses. The lake's regulation schedule will be modified and plan features constructed to reduce the extreme high and low levels that damage the lake and its shoreline. Management of intermediate water levels will be improved, while allowing the lake to continue to serve as an important source for water supply. Several plan components and Other Project Elements are included to improve water quality conditions in the lake. A study is recommended to evaluate in detail the dredging of nutrient-enriched lake sediments to help achieve water quality restoration targets, important not only for the lake, but also for downstream receiving bodies.

Improve Water Deliveries to Estuaries. Excess stormwater that is discharged to the ocean and the gulf through the Caloosahatchee and St. Lucie rivers is very damaging to their respective estuaries. The recommended Comprehensive Plan will greatly reduce these discharges by storing excess runoff in surface and underground water storage areas. During times of low rainfall, the stored water can be used to augment flow to the estuaries. Damaging high flows will also be reduced to the Lake Worth Lagoon.

Underground Water Storage. Wells and associated infrastructure will be built to store water in the upper Floridan aquifer. As much as 1.6 billion gallons a day may be pumped down the wells into underground storage zones. The injected fresh water, which does not mix with the saline aquifer water, is stored in a "bubble" and can be pumped out during dry periods. This approach, known as aquifer storage and recovery, has been used for years on a smaller scale to augment municipal water supplies. Since water does not evaporate when stored underground and less land is required for storage, aquifer storage and recovery has some advantages over surface storage. The recommended Comprehensive Plan includes aquifer storage and recovery wells around Lake Okeechobee, in the Water Preserve Areas, and the Caloosahatchee Basin.

Treatment Wetlands. Approximately 35,600 acres of manmade wetlands, known as stormwater treatment areas, will be built to treat urban and agricultural runoff water before it is discharged to the natural areas throughout the system. Stormwater treatment areas are included in the recommended Comprehensive Plan for basins draining to Lake Okeechobee, the Caloosahatchee River Basin, the St. Lucie Estuary Basin, the Everglades, and the Lower East Coast. These are in addition to the over 44,000 acres of stormwater treatment areas already being constructed pursuant to the Everglades Forever Act to treat water discharged from the Everglades Agricultural Area.

Improve Water Deliveries to the Everglades. The volume, timing, and quality of water delivered to the south Florida ecosystem will be greatly improved. The Comprehensive Plan will deliver an average of 26 percent more water into Northeast Shark River Slough over current conditions. This translates into nearly a half million acre-feet of additional water reaching the slough, and is especially critical in the dry season. More natural refinements will be made to the rainfall-driven operational plan to enhance the timing of water sent to the Water Conservation Areas, Everglades National Park, and the Holey Land and Rotenberger Wildlife Management Areas.

Remove Barriers to Sheetflow. More than 240 miles of project canals and internal levees within the Everglades will be removed to reestablish the natural sheetflow of water through the Everglades. Most of the Miami Canal in Water Conservation Area 3 will be removed and 20 miles of the Tamiami Trail (U.S. Route 41) will be rebuilt with bridges and culverts, allowing water to flow more naturally into Everglades National Park, as it once did. In the Big Cypress National Preserve, a north-south levee will be removed to restore more natural overland water flow.

Store Water in Existing Quarries. Two limestone quarries in northern Miami-Dade County will be converted to water storage reservoirs to supply Florida Bay, the Everglades, Biscayne Bay, and Miami-Dade County residents with water. The 11,000-acre area will be ringed with an seepage barriers to ensure that stored water does not leak or adjacent groundwater does not seep into the area. A similar facility will be constructed in northern Palm Beach County.

Reuse Wastewater. The recommended Comprehensive Plan includes two advanced wastewater treatment plants in Miami-Dade County capable of making more than 220 million gallons a day of the county's treated wastewater clean enough to discharge into wetlands along Biscayne Bay and for recharging the Biscayne Aquifer. This reuse of water will improve water supplies to south Miami-Dade County as well as reducing seepage from the Northeast Shark River Slough area of the Everglades. Given the high cost associated with using reuse to meet the ecological goals and objectives for Biscayne Bay, other potential sources of water to provide freshwater flows to the central and southern bay will be investigated before pursuing reuse.

Pilot Projects. A number of technologies proposed in the Comprehensive Plan have uncertainties associated with them -- either in the technology itself, its application, or in the scale of implementation. While none of the proposed technologies are untested, what is not known is whether actual performance will measure up to that anticipated in the Comprehensive Plan. The pilot projects, which include wastewater reuse, seepage management, Lake Belt technology, and three aquifer storage and recovery projects are recommended to address uncertainties prior to full implementation of these components.

Improve Fresh Water Flows to Florida Bay. Improved water deliveries to Shark River Slough, Taylor Slough, and wetlands to the east of Everglades National Park will in turn provide improved deliveries of fresh water flows to Florida Bay. A feasibility study is also recommended to evaluate additional environmental restoration needs in Florida Bay and the Florida Keys.

Southwest Florida. There are additional water resources problems and opportunities in southwest Florida requiring studies beyond the scope of the Restudy recommended Comprehensive Plan. In this regard, a feasibility study for Southwest Florida is being recommended to investigate the region's hydrologic and ecological restoration needs.

Comprehensive Integrated Water Quality Plan. The recommended Comprehensive Plan includes a follow-on feasibility study to develop a comprehensive water quality plan to ensure that the Comprehensive Plan leads to ecosystem restoration throughout south Florida. The water quality feasibility study would include evaluating water quality standards and criteria from an ecosystem restoration perspective and recommendations for integrating existing and future water quality restoration targets for south Florida water bodies into future planning, design, and construction activities to facilitate implementation of the recommended Comprehensive Plan. Further, water quality in the Keys is critical to ecosystem restoration. The Florida Keys Water Quality Protection Plan includes measures for improving wastewater and stormwater treatment within the Keys. Implementation of the Keys Water Quality Protection Plan is critical for restoration of the south Florida ecosystem.

Overall, the recommended Comprehensive Plan will capture and store much of the water that is now lost to the ocean and gulf. This will provide enough water in the future for both the ecosystem, as well as urban and agricultural users. It will continue to provide the same level of flood protection as it does at present, if not more, for south Florida. The Comprehensive Plan is a system-wide solution for ecosystem restoration, water supply, and flood damage reduction. It is a necessary step towards a sustainable south Florida.

What the Comprehensive Plan Will Accomplish

Implementation of the recommended Comprehensive Plan will result in the recovery of healthy, sustainable ecosystems throughout south Florida. It is a plan that will lead to a much improved environment, for people and for the plants and animals that depend upon the natural system for their survival. The Comprehensive Plan contains all of the essential components to achieve this goal. There are many reasons for having confidence that it will be successful. No other plan, especially one on a smaller scale or one lacking the appropriate balance between ecosystem restoration and future urban and agricultural water supply objectives, would achieve a similar level of success.

The Comprehensive Plan does not provide all the answers – no plan could. The plan, however, contains an aggressive adaptive assessment strategy that includes independent scientific peer review and a process for identifying and resolving uncertainties. Because it is acknowledged that all the answers cannot be known at this time, and that inaction is not an option, adaptive assessment provides the means to allow restoration to move forward. A major strength of the current plan is that its flexibility allows for efficient and successive opportunities to make further improvements as we refine our plans and obtain new information.

The focus of the recommended Comprehensive Plan has been on recovering the defining ecological features of the original Everglades and other south Florida ecosystems. What made these ecosystems unique was their topographic flatness and expansiveness, and that they formed hydrologically integrated systems from boundary to boundary. What this means in a healthy ecosystem is that water patterns in one part of the system could be used to predict the patterns throughout the system. Animals living in the Everglades would "read" the water patterns, and "know" where to go to find the food and water that they needed for successful reproduction and survival under a range of natural conditions. It was the combination of connectivity and space that created the range of habitats needed for the diversity of plants and animals. The construction of the many levees and dikes designed to compartmentalize the Everglades and separate Lake Okeechobee from its natural overflow, and the canals that drained water to the coast, disrupted these natural patterns, and destroyed the ability of many animals to find the dependable habitat needed for their survival at the right time.

The recommended Comprehensive Plan, by removing over 240 miles of internal levees in the Everglades, and approaching recovery of the natural volume of water in the remaining wetlands, will restore these essential defining features of the pre-drainage wetlands over large portions of the remaining system. The plan also includes water storage and water quality treatment areas that will improve water quality conditions in the south Florida ecosystem. In response to this substantial improvement, the characteristic animals of these ecosystems will show dramatic and positive responses. At all levels in the aquatic food chains, the numbers of such animals as crayfish, minnows, sunfish, frogs, alligators, herons, ibis, and otters, will markedly increase. Equally important, animals will respond to the recovery of more natural water patterns by returning to their traditional distribution patterns.

The recommended Comprehensive Plan will support the return of the large nesting "rookeries" of wading birds to Everglades National Park, and the recovery of several endangered species to more certain and optimistic futures. Wading birds, e.g., herons, egrets, ibis and storks, are symbolic of the overall health of the Everglades. As recently as the 1950s and 1960s, large "super colonies" of nesting waders remained in the park; none have been there since. Wading birds, perhaps more than any other animal, assess the quality of habitats over the entire basin of south Florida

wetlands, before making "decisions" about where and when, or even whether, to nest. The recovery of the super colonies will be a sure sign that the entire ecosystem has made substantial progress towards recovery. Of the endangered species, the wood stork, snail kite, Cape Sable seaside sparrow, and American crocodile, among others, will benefit and increase. Undoubtedly, implementation of the recommended Comprehensive Plan will once again allow us to witness what is now only a fading memory of the former abundance of wildlife in the Everglades.

It is important to understand that the "restored" Everglades of the future will be different from any version of the Everglades that has existed in the past. While it certainly will be vastly superior to the current ecosystem, it will not completely match the pre-drainage system. This is not possible, in light of the irreversible physical changes that have made to the ecosystem. It will be an Everglades that is smaller and somewhat differently arranged than the historic ecosystem. But it will be a successfully restored Everglades, because it will have recovered those hydrological and biological patterns which defined the original Everglades, and which made it unique among the world's wetland systems. It will become a place that kindles the wildness and richness of the former Everglades.

Lake Okeechobee will once again become a healthy lake. The littoral and pelagic zones within the lake, essential to the lake's commercial and recreational fishery and other aquatic species, will be greatly enhanced by the water levels projected in the recommended Comprehensive Plan. Water quality will also be improved significantly. The lake provides huge regional benefits to wildlife, including waterfowl, other birds, and mammals.

The Comprehensive Plan provides major benefits to the Caloosahatchee and St. Lucie estuaries, and Lake Worth Lagoon. The plan eliminates almost all the damaging fresh water releases to the Caloosahatchee and most detrimental releases to the St. Lucie. The plan makes substantial improvements to Lake Worth Lagoon. As a result, grassbeds and other submerged aquatic vegetation will benefit and thus provide abundant favorable habitat for the many aquatic species that depend on these areas for food, shelter, and breeding grounds, thereby enhancing the productivity and economic viability of estuarine fisheries. The recommended Comprehensive Plan also includes several water storage and treatment areas to improve water quality conditions in the Indian River Lagoon and the St. Lucie and Caloosahatchee estuarine systems.

The recommended Comprehensive Plan makes improvements in fresh water deliveries to Florida and Biscayne bays. These bays will benefit from more natural water deliveries. Appropriate fresh water regimes will result in substantial improvements in aquatic and semi-aquatic habitats; fish and wildlife will respond favorably to these beneficial changes. Mangroves, coastal marshes, and seagrass beds interacting together to

> produce food, shelter, and breeding and nursery grounds will support more balanced, productive fish, shellfish, and wildlife communities.
>
> South Florida does not have to follow the fate of some states that suffer severe water shortages, creating tension between natural resource protection and water supply. The recommended Comprehensive Plan expands the storage capability of the C&SF Project, enabling the system to better meet ecosystem and urban water supply needs in the future. Frequency of water restrictions expected with the recommended Comprehensive Plan are greatly reduced compared to the Without Plan Condition. This will be accomplished by more effectively providing adequate flows from the regional system to recharge the surficial aquifer. This will help offset withdrawals from public water supply wellfields and other users in the urbanized Lower East Coast Region. Such recharge also protects the surficial aquifer from saltwater intrusion, allowing it to remain a productive source of fresh water in the future.
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> The recommended Comprehensive Plan will significantly increase the capability to supply water from the regional system to agricultural users. This will provide better protection from economically harmful water supply cutbacks and allow agriculture to remain productive. Storage facilities associated with Lake Okeechobee such as those north of the lake, and Lake Okeechobee aquifer storage and recovery will enable the lake to remain an important source of water supply while keeping lake stages at more ecologically desirable levels. Additional storage facilities built throughout the system will diversify sources of water for many users and enable recycling of water within a basin to meet dry season demands, significantly improving the reliability of agricultural water supply in the future.
>
> The recommended Comprehensive Plan also assures that the quality of south Florida's water bodies will be restored to achieve overall ecosystem restoration. The recommended Comprehensive Plan includes many features to assure that water quality standards will be met and water quality conditions are improved or not degraded. The Comprehensive Plan includes the development of a comprehensive integrated water quality plan, which will lead to recommendations for water quality remediation programs and the integration of water quality restoration targets into future design, construction, and operation activities as features of the recommended Comprehensive Plan are implemented.

A sense of the geographic distribution of the major CERP projects can be gained by reference to **Figure 39** in which the projects have been grouped into 22 categories. A summary of CERP components, their costs, areas they benefit and timelines for the projects is presented in **Table 47**. Note that this information is based on the Implementation Plan in the Central and Southern Florida Project Comprehensive Review Study (April 1999). Additional detail on expected non-federal funding responsibilities are presented in Chapter 6.The major focus of evaluations of CERP components was on their aggregate performance in meeting water supply and environmental performance goals.

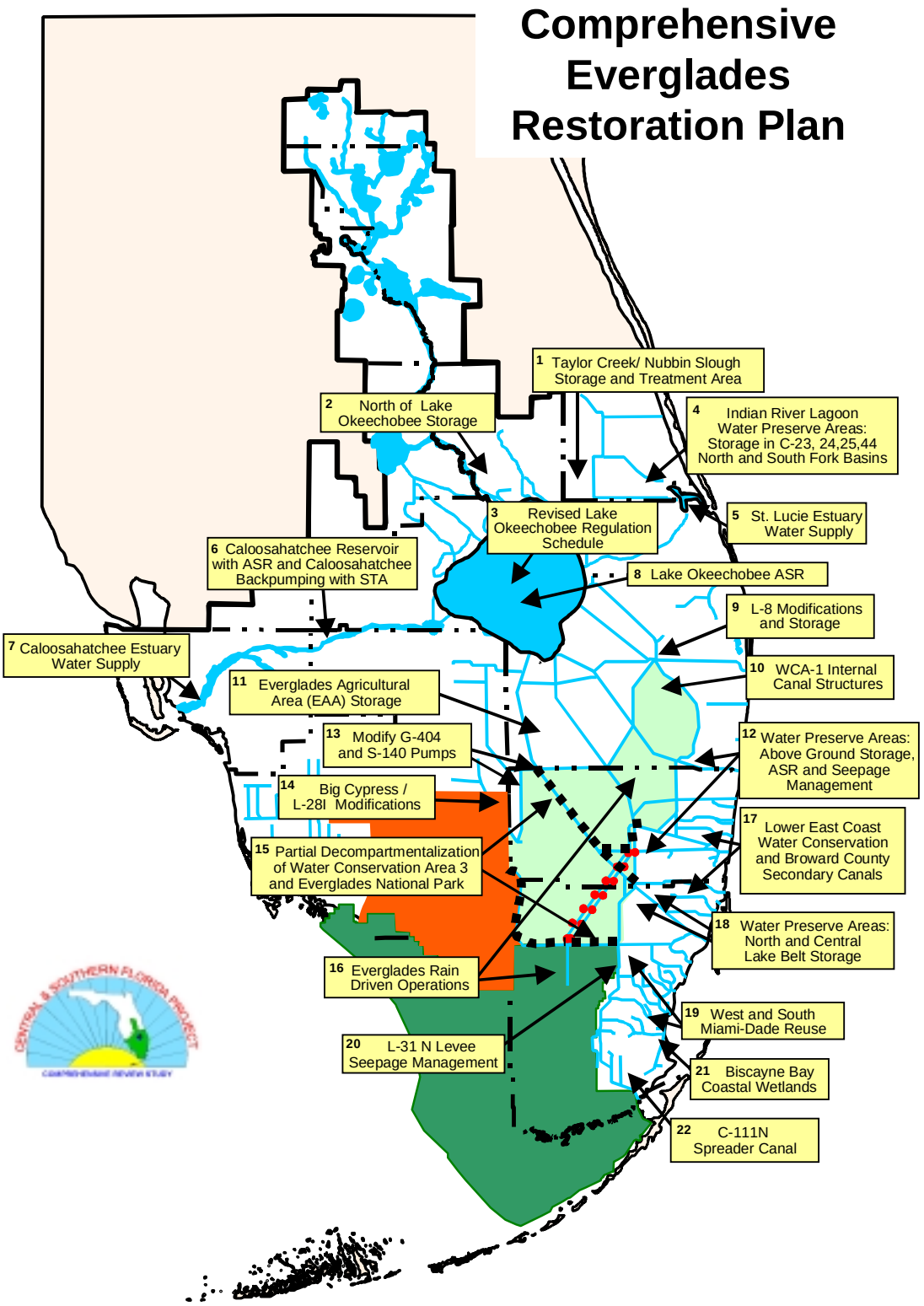

Figure 39. Locations of Major Comprehensive Everglades Restoration Plan (CERP) Projects.

CENTRAL AND SOUTHERN FLORIDA PROJECT COMPREHENSIVE REVIEW STUDY

ID	Component	Benefit	Duration	Start	Finish	Cost
1	Lake Okeechobee ASR Pilot	Feasibility	260 wks	Thu 7/1/99	Wed 6/23/04	$19,000,000
2	Caloosahatchee ASR Pilot	Feasibility	260 wks	Wed 11/1/00	Tue 10/25/05	$6,000,000
3	Seepage Mgmt Pilot	Feasibility	156 wks	Wed 11/1/00	Tue 10/28/03	$10,000,000
4	Hillsboro (Site 1) ASR Pilot	Feasibility	174.4 wks	Thu 7/1/99	Fri 11/1/02	$9,000,000
5	Lakebelt Technology Pilot	Feasibility	650 wks	Thu 7/1/99	Wed 12/14/11	$23,000,000
6	Reuse Technology Pilot	Feasibility	416 wks	Fri 10/1/99	Thu 9/20/07	$30,000,000
7	Holeyland Reg. Schedule	Timing	672 wks	Mon 1/31/00	Fri 12/14/12	$0
8	Rotenberger Reg. Schedule	Timing	52 wks	Mon 1/31/00	Fri 1/26/01	$0
9	WCA-1 Internal Structures	Distribution	182 wks	Mon 1/31/00	Fri 7/25/03	$7,669,000
10	C-111 Operations Mod	Timing	100.4 wks	Wed 5/1/02	Thu 4/1/04	$0
11	C-111N Spreader Canal	Distribution	442 wks	Mon 1/31/00	Fri 7/18/08	$94,035,000
12	C-4 Divide Structures	Quantity, Distribution	286 wks	Mon 1/31/00	Fri 7/22/05	$2,330,000
13	Modify G-404 Pump Station	Distribution	286 wks	Wed 10/1/03	Tue 3/24/09	$10,138,000
14	C-44 Basin Storage	Quantity, Quality, Timing	416 wks	Mon 7/5/99	Fri 6/22/07	$112,562,000
15	Upper East Coast Storage	Quantity, Quality, Timing	569 wks	Mon 7/5/99	Fri 5/28/10	$710,223,000
16	EAA Storage	Quantity, Quality, Timing	860.4 wks	Thu 7/1/99	Fri 12/25/15	$436,648,000
17	North of Lake O Storage/STA	Quantity, Quality, Timing	520 wks	Mon 10/3/05	Fri 9/18/15	$284,854,000
18	Taylor Ck/Nubbin Slough Storage/STA	Quantity, Quality, Timing	468 wks	Mon 1/31/00	Fri 1/16/09	$104,027,000
19	C-43 Basin Storage & ASR	Quantity, Quality, Timing	616.2 wks	Thu 6/1/00	Thu 3/22/12	$440,195,000
20	C-43 Basin STA/Backpumping	Quantity, Quality, Timing	520 wks	Mon 10/3/05	Fri 9/18/15	$82,895,000
21	C-9 Impoundment	Quantity, Quality, Timing	312 wks	Mon 10/1/01	Fri 9/21/07	$89,146,000
22	Western C-11 Diversion	Quantity, Quality, Timing	364 wks	Mon 10/1/01	Fri 9/19/08	$124,837,000
23	Dade Broward Levee Imprvmt	Quantity, Distribution	364 wks	Mon 10/1/01	Fri 9/19/08	$18,778,000
24	Hillsboro(Site 1) Impoundment/ASR	Quantity, Quality, Timing	681.2 wks	Fri 9/28/01	Fri 10/17/14	$131,379,000
25	ACME Basin B Discharge	Quantity, Quality, Timing	260 wks	Mon 10/1/01	Fri 9/22/06	$20,100,000

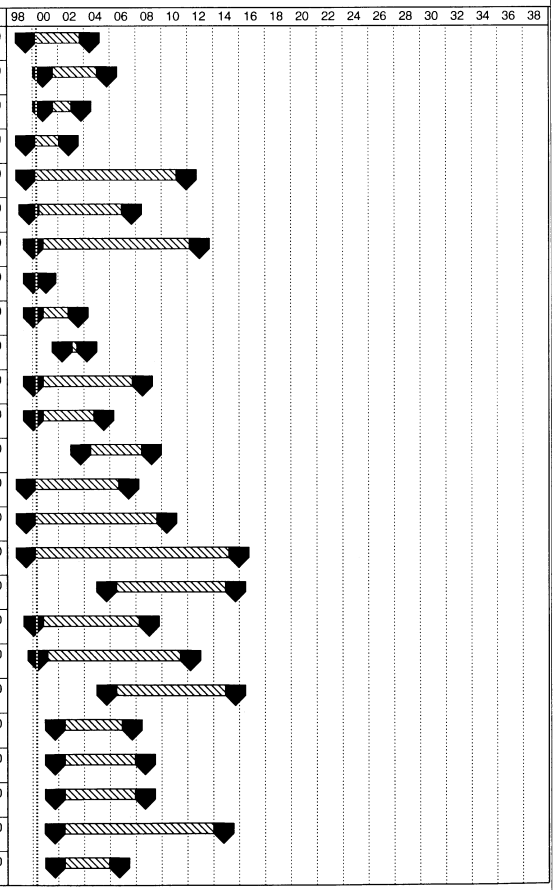

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Figure 40. A Summary of CERP Components, Their Costs, Areas They Benefit and Timelines for the Projects.

CENTRAL AND SOUTHERN FLORIDA PROJECT COMPREHENSIVE REVIEW STUDY

ID	Component	Benefit	Duration	Start	Finish	Cost
26	Protect Strazulla Wetlands (LNWR)	Spatial Extent	317.2 wks	Fri 9/28/01	Fri 10/26/07	$52,772,000
27	Pal Mar-Corbett Hydropattern Rest'n	Distribution, Spatial Extent	260 wks	Mon 10/1/01	Fri 9/22/06	$10,500,000
28	Bird Drive Basin Impoundment	Quantity, Quality, Timing	520 wks	Thu 1/1/04	Wed 12/18/13	$124,083,000
29	C-17 Backpumping/Treatment	Quantity, Quality, Timing	312 wks	Mon 11/4/02	Fri 10/24/08	$20,190,000
30	C-51 Backpumping/Treatment	Quantity, Quality, Timing	312 wks	Mon 11/4/02	Fri 10/24/08	$32,632,000
31	L-31N Levee Improvement	Quantity, Distribution	416 wks	Wed 10/30/02	Tue 10/19/10	$66,795,000
32	WCA 3A & 3B Seepage Mgmt	Quantity, Distribution	364 wks	Tue 10/2/01	Mon 9/22/08	$101,243,000
33	S-356 Structures	Distribution	260 wks	Mon 11/4/02	Fri 10/26/07	$116,514,000
34	Additional L-8 Improvements	Quantity, Quality, Timing	364 wks	Mon 9/27/04	Fri 9/16/11	$73,913,000
35	C-51/Southern L-8 Reservoir	Quantity, Quality, Timing	520 wks	Mon 9/27/04	Fri 9/12/14	$340,000,000
36	C-51 Regional Groundwater ASR	Quantity, Timing	468 wks	Mon 9/27/04	Fri 9/13/13	$131,925,000
37	Ag Reserve Reservoir	Quantity, Quality, Timing	416 wks	Thu 9/1/05	Wed 8/21/13	$125,778,000
38	Central Lakebelt Storage	Quantity, Quality, Timing	1295 wks	Mon 2/27/12	Fri 12/19/36	$482,295,000
39	Flows from CLB to Eastern WCA-3B	Distribution	260 wks	Mon 2/27/12	Fri 2/17/17	$6,762,000
40	Divert WCA-3 Flows to CLB	Distribution	338 wks	Mon 4/1/02	Fri 9/19/08	$790,000
41	Divert WCA-2 Flows to CLB	Distribution	442 wks	Mon 4/1/02	Fri 9/17/10	$78,696,000
42	North Lake Belt Storage	Quantity, Quality, Timing	1269 wks	Mon 2/27/12	Fri 6/20/36	$517,036,000
43	N. New River Canal Conveyance	Distribution	364 wks	Mon 1/28/02	Fri 1/16/09	$77,620,000
44	Additional S-345 Structures	Distribution	364 wks	Mon 1/28/02	Fri 1/16/09	$48,093,000
45	Decompartmentalize WCA-3	Distribution	884 wks	Mon 1/28/02	Fri 1/4/19	$85,974,000
46	Biscayne Bay Coastal Wetlands	Distribution	984 wks	Thu 7/1/99	Wed 5/9/18	$292,000,000
47	Biscayne Bay Coastal Canals	Distribution	984 wks	Thu 7/1/99	Wed 5/9/18	$7,583,000
48	West Miami-Dade Reuse	Quantity, Quality, Distrib	468 wks	Mon 7/4/11	Fri 6/19/20	$437,237,000
49	South Miami-Dade Reuse	Quantity, Quality, Distrib	468 wks	Mon 7/4/11	Fri 6/19/20	$363,024,000
50	LEC Water Conservation	Timing	1950 wks	Thu 7/1/99	Wed 11/12/36	$0

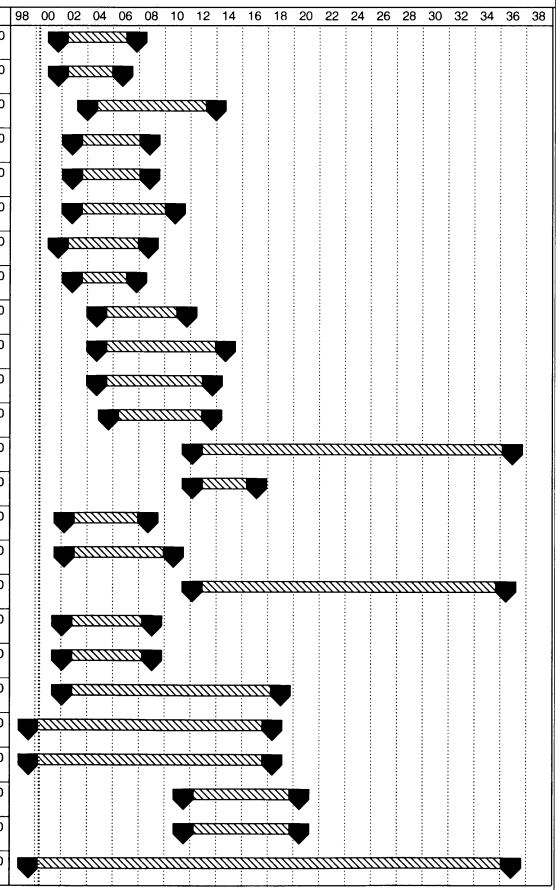

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Figure 40. Continued Summary of CERP Components, Their Costs, Areas They Benefit and Timelines for the

CENTRAL AND SOUTHERN FLORIDA PROJECT COMPREHENSIVE REVIEW STUDY

ID	Component	Benefit	Duration	Start	Finish	Cost
51	Broward Secondary Canals	Distribution	415 wks	Mon 7/2/01	Fri 6/12/09	$12,898,000
52	Miccosukee Water Mgmt Plan	Quantity, Quality, Timing	442 wks	Mon 7/3/00	Fri 12/19/08	$24,459,000
53	Flows to NW/Central WCA-3A	Distribution	442 wks	Thu 11/2/00	Wed 4/22/09	$20,739,000
54	Big Cypress/L-28 Interceptor	Quan, Qual, Timing, Distr	520 wks	Mon 10/2/06	Fri 9/16/16	$42,751,000
55	Seminole Water Conservation Plan	Quantity, Quality, Timing	390 wks	Mon 1/1/01	Fri 6/20/08	$75,288,000
56	Lake Okeechobee ASR	Quantity, Timing	834 wks	Thu 6/24/04	Wed 6/17/20	$1,097,312,000
57	Lake Okee Water Quality Treatment	Qnty,Qlty,Tmg,Spat'l Ext	468 wks	Mon 10/1/01	Fri 9/17/10	$62,247,000
58	Lake Okee Tributary TP Removal	Quality	208 wks	Tue 10/2/01	Mon 9/26/05	$4,700,000
59	Lake Istokpoga Reg. Schedule	Quantity, Quality, Timing	78 wks	Mon 7/3/00	Fri 12/28/01	$50,000
60	S Golden Gate Estates Rest'n	Quantity, Quality, Distrib.	312 wks	Thu 7/1/99	Wed 6/22/05	$45,654,000
61	Southern Crew Project Add'n	Quality, Distrib, Spat'l Ext	312 wks	Thu 7/1/99	Wed 6/22/05	$3,435,000
62	Lake Trafford Restoration	Quality, Spatial Extent	286 wks	Thu 7/1/99	Wed 12/22/04	$15,408,000
63	Lake Worth Lagoon Restoration	Quality	286 wks	Tue 10/4/05	Mon 3/28/11	$2,300,000
64	Pineland Hardwood Restoration	Spatial Extent	286 wks	Mon 10/2/00	Fri 3/24/06	$600,000
65	Melaleuca/Exotic Plant Eradication	Exotic Plant Control	260 wks	Mon 10/2/06	Fri 9/23/11	$5,772,000
66	Florida Keys Tidal Restoration	Distribution	286 wks	Mon 3/6/00	Fri 8/26/05	$1,251,000
67	Henderson Crk/Belle Meade Rest'n	Spatial Extent	312 wks	Mon 1/3/00	Fri 12/23/05	$4,806,000
68	Winsburg Farms Wetlands	Quantity, Quality, Timing	312 wks	Mon 1/3/00	Fri 12/23/05	$14,140,000
69	Lakes Park Restoration	Quantity, Quality	260 wks	Thu 7/1/99	Wed 6/23/04	$5,166,000
70	SW Florida Feasibility Study	Feasibility	260 wks	Thu 4/1/99	Wed 3/24/04	$8,100,000
71	Florida Bay/Keys Feasibility Study	Feasibility	260.2 wks	Fri 10/29/99	Fri 10/22/04	$4,100,000
72	Comprehensive Water Quality Plan	Feasibility	377.2 wks	Fri 10/1/99	Fri 12/22/06	$8,100,000
73	RECOVER/Monitoring	Adaptive Assessment	2060 wks	Thu 7/1/99	Wed 12/22/38	$387,000,000
74	**Comprehensive Review Plan**		**2073 wks**	**Thu 4/1/99**	**Wed 12/22/38**	**$8,206,547,000**

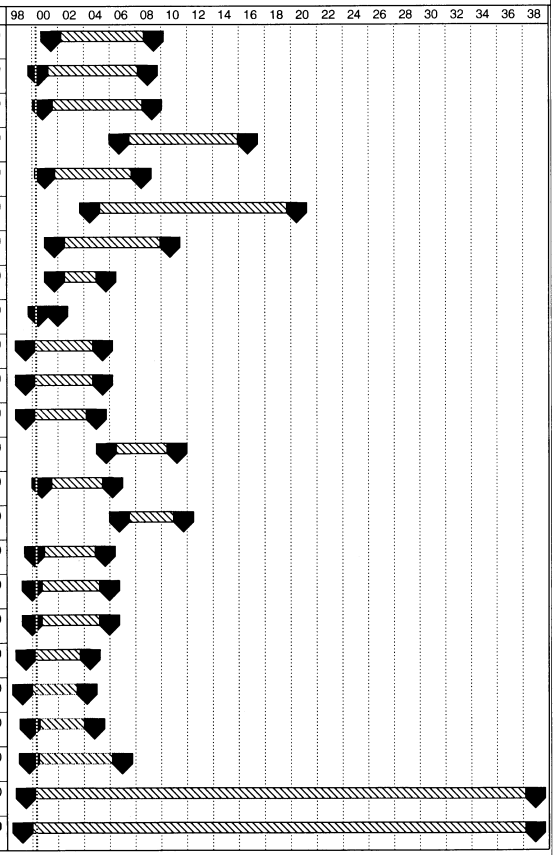

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Figure 40. Continued Summary of CERP Components, Their Costs, Areas They Benefit and Timelines for the

These results were discussed in Chapter 4. For the LEC Plan, it is also important to identify the amount of water provided by each of the components. This amount of water can be considered at two levels, the capacity of the component and the amount delivered under specific water supply conditions. **Table 48** presents information on the capacity of those CERP components for which a specific water supply capacity can be attributed. **Table 49** presents results from the SFWMM run with the best performance, the LEC-1 Revised run, and shows the amounts of water provided by key CERP features on an average annual basis for the 31 year simulation and for five drought years. **Table 50** presents similar information from the viewpoint of the demand area, listing the amounts of water delivered to each demand area each relevant component. Additional detail on water provided by CERP features and sources of water delivered by demand area are presented in Appendix I.

Table 48. Minimum and Maximum Water Delivered to Major Features within the Lower East Coast Planning Area

Component	Water Delivered	
	Minimum	Maximum
Lake Okeechobee ASR	1K MGD ASR	
North of Lake Okeechobee Storage Reservoir	100K ac-ft	200K ac-ft
St. Lucie/C-44 Basin Storage Reservoir	20K ac-ft	40K ac-ft
Caloosahatchee/ C-43 Basin Storage Reservoir with ASR	80K ac-ft	160K ac-ft reservoir 220 MGD ASR
L-8 Project	25 MGD ASR	50 MGD ASR 48K ac-ft reservoir
Taylor Creek/Nubbin Slough STA	50K ac-ft reservoir 20K ac-ft STA	50K ac-ft reservoir 20K ac-ft STA
St. Lucie River Estuary, C-23, and C-24 Storage Reservoirs	165K ac-ft	192K ac-ft
EAA Storage Reservoir	240k ac-ft	360K ac-ft
C-51 and Southern L-8 Reservoir	120K ac-ft	120K ac-ft
Hillsboro Impoundment	10K ac-ft	14.8K ac-ft
Hillsboro ASR	220 MGD ASR	370 MGD ASR
C-51 Regional Ground Water ASR	340 MGD ASR	540 MGD ASR
Palm Beach County Agricultural Reserve Reservoir	10K ac-ft	19.9K ac-ft reservoir 75 MGD ASR
Western C-11 Diversion Impoundment and Canal	6.4K ac-ft	6.4K ac-ft
C-9 STA/Impoundment	10K ac-ft	10K ac-ft
North Lake Belt Storage Area	70K ac-ft	90K ac-ft
Central Lake Belt Storage Area	80K ac-ft	187.2K ac-ft
Bird Drive Recharge Area	11.5K ac-ft	11.5K ac-ft
L-31N Levee Improvements for Seepage Management	100% Levee; 100% ground water	100% Levee; 100% west season ground water
South Miami-Dade County Reuse (South District Reclaimed Water Treatment Plant)	131 MGD capacity	131 MGD capacity
West Miami-Dade Reuse	100 MGD capacity	

The implementing process for the CERP is presented in Chapter 10 of the Central and Southern Florida Project Comprehensive Review Study. For construction features, work will be conducted in planning, engineering and design (PED); real estate acquisition;

Table 49. Average Annual Amounts of Water Provided (1,000 ac. ft.) by Lower East Coast Water Supply Plan Components.

Component	Beneficiary	LEC-1 Revised – Average Annual Water Provided for the Simulation Period	Average Annual Water Provided During Drought Years (71,75,81,86,89).
St. Lucie Reservoir	Basin water supply	1	1
	St. Lucie Estuary	8	0
	To LOK	10	8
North of LOK Storage (recovery)	Entire System (via LOK)	49	40
LOK ASR (recovery)	Entire System (via LOK)	115	256
EAA Compartment 1	EAA Ag. Water Supply	204	168
	To Compartment 2A	20	26
EAA Compartment 2A	EAA Ag. Water Supply	6	2
	Glades	122	42
EAA Compartment 2B	Glades	110	8
Service Area – 1+NPB Reservoirs	Service Area – 1+NPB users	10	13
Service Area – 1+NPB ASR	Service Area – 1+NPB users	51	76
	EAA	37	30
Service Area –2 ASR	Service Area – 2 users	32	42
Lake Belt North Reservoir	SA-3 Water Supply	25	27
	Biscayne Bay	109	70
Central Lake Belt Reservoir	Glades	59	75
	Biscayne Bay	27	8
Bird Drive Rechage Area	SA-3 Water supply	15	19
Southern Reuse facility	Biscayne Bay	147	147
Western Reuse facility	To Bird Drive Recharge Area	56	56
S-336B, S-338 Structures	To Biscayne Bay	8	6

and construction. Where appropriate, pilot projects will be conducted to resolve uncertainties before additional planning efforts are undertaken. Operations, maintenance, repair, replacement and rehabilitation costs will be incurred for each feature once it becomes operational. Operational features that include operational strategies and criteria, such as rainfall driven water delivery schedules, will be implemented to achieve

Table 50. Average Annual Basin by Basin Demands for the 31 Year Simulation Period and for Drought Years and How They Are Met.

Demand Basin/ Water Body	Total Demand and/or Sources of Supply	LEC-1 Revised Average for 31-Year Simulation Period (1,000 of acre-feet)	LEC-1 Revised Average for Five Drought Years - 1971,1975, 1981, 1985 1989 (1,000 of acre-feet)
Caloosahatchee Basin (surface water demand)	Lake Okeechobee	29	57
	Local Reservoir	Addressed by the Caloosahatchee Water Management Plan	
	Caloosahatchee Basin ASR		
	Local Sources+Rainfall		
	Demand Not Met		
St. Lucie Basin (surface water demand)	Lake Okeechobee	25	48
	St. Lucie Reservoir	1	1
	Demand Not Met	1	5
EAA	Lake Okeechobee	85	205
	EAA Reservoirs	209	170
	SA-1 Regional ASR	37	30
	Local Sources+Rainfall	905	832
	Demand Not Met	8	40
LEC Service Area-1 (to maintain coastal canals)	Lake Okeechobee	3	11
	Water Conservation Areas	32	75
	SA-1 Reservoirs	10	13
	SA-1 Regional ASR	51	76
LEC Service Area-2 (to maintain canals)	Lake Okeechobee	9	27
	Water Conservation Areas	8	15
	SA-1 Regional ASR	32	42
LEC Service Area-3 (to maintain canals)	Lake Okeechobee	77	212
	Water Conservation Areas	24	29
	SA-3 Reservoirs	40	46
Caloosahatchee Estuary	Caloosahatchee Basin Reservoir	Addressed by the Caloosahatchee Water Management Plan	
	Local Basin Runoff		
	Lake Okeechobee (Environmental)	16	31
	Lake Okeechobee (Regulatory)	28	0
St. Lucie Estuary	St. Lucie Basin Reservoir	8	0
	Local Basin Runoff[a]	587	313
	Lake Okeechobee (Environmental)	14	1
	Lake Okeechobee (Regulatory)	12	0
Glades (WCAs+ENP)-rain driven demand	Lake Okeechobee[b]	193	222
	EAA Reservoirs	232	50
	EAA Drainage South[c]	662	536
	Regulatory from LOK	96	0
Everglades National Park	NW Shark River Slough	451	183
	NE Shark River Slough	685	306
Biscayne Bay	Snake Creek (S29)	114	81
	North Bay (G58+S28+S27)	145	111
	Miami River (S26+S25B+S25)	60	33
	Central Bay (G97+S22+S123)	203	135
	South Bay(S21+S21A+S20F+S20G+S197)	268	210

a. Includes all contributing basins to the St. Lucie estuary (C-23, C-24, NorthFork, SouthFork and C-44)
b. Environmental releases from LOK to meet rain-driven demands
c. Includes flows from Holey Land and Rotenberger

maximum benefits from the features in place at any given time. In addition, a comprehensive monitoring and adaptive assessment program (restoration, coordination and verification (RECOVER)) will be undertaken to assess system conditions and responses and provide guidance in the design and operation of components.

The Comprehensive Plan was developed through an inclusive and open process that engaged all stakeholders. All applicable federal, tribal, state and local agencies were full partners and their views were fully considered. The implementation process for the CERP will continue this effort and facilitate project modifications that are needed to take advantage of what is learned from system responses and as future restoration targets become more refined.

One key opportunity for public input and guidance will be as part of the development of the Project Implementation Reports (PIRs). Public input to the PIR process, including input from the LEC Advisory committee and individual members, will guide the locations, capabilities and general design features of the components. Evaluations to assure the maintenance or improvement of flood protection and evaluations of the potential for recreational development will be part of the PIR process. The PIR process will facilitate participation in the further design of the components. In addition, public input to the PIR process will be sought and provided through the required completion of the National Environmental Policy Act documentation.

In addition, the two existing feasibility studies (Water Preserve Area Feasibility Study and Indian River Lagoon Feasibility Study) will be completed and three new feasibility studies (Florida Bay and the Florida Keys, Southwest Florida and a Comprehensive Integrated Water Quality Plan) are being undertaken. The extensive outreach and public involvement, both of which have been an essential part of the Restudy, will continue during the completion of these feasibility studies.

Finally the RECOVER process which is charged with addressing system-wide issues through evaluations and analyses is anticipated to include a public involvement and outreach team. RECOVER team input will be particularly important to the LEC Committee since they will be tracking both system-wide performance and regional contributions that will be realized from specific projects.

In addition to the other public outreach efforts, representatives from the CERP teams dealing with relevant PIRs and feasibility studies and the RECOVER process should update the LEC Committee at regular Committee meetings and receive LEC Committee input regarding CERP directions and efforts.

Guidance to CERP From the LEC Plan

As a result of the evaluations conducted in the LEC Planning process and in the development of the Caloosahatchee Water Management Plan, valuable insights have been developed regarding the potential design and operation of CERP projects. These insights should be incorporated into CERP planning and implementation efforts. The consideration of these insights is therefore treated as a formal recommendation of the LEC Plan to CERP.

The individual recommendations are further described and discussed in Chapter 6. They include the following:

- The identification of the need for additional analyses related to the implications of the planned location of S-155A on CERP components (Recommendation 19),
- A reiteration of the importance that CERP planning and RECOVER Team efforts identify additional improvements for WCA-2B, which was the only area of the northern Everglades that received a “RED” score in LEC and Restudy efforts to date (Recommendation 20),
- Changes in the compartments proposed for the EAA reservoir to increase storage available to meet EAA demands and increased utilization of the reservoir to meet demands in the West Palm Beach Canal Area of the EAA (Recommendation 21),
- Increase utilization of ASR water in the C-51, West Palm Beach Catchment Area and Hillsboro systems above those achieved in Restudy evaluations. Use of the C-51 and West Palm Beach Catchment Area water to meet demands in the EAA is suggested. Use of Hillsboro ASR water to meet demands in Service Area 2 is recommended (Recommendations 22, 23).
- Consideration of different capacities and uses of the West Miami-Dade Reuse system is recommended (Recommendation 24).
- Modifications of Lake Okeechobee Regulation schedules to achieve the best performance given the structural improvements that may be in place at various times during the plan implementation (Recommendation 25),
- As early-as-possible implementation of the Lakebelt Storage Areas (Recommendation 26),
- ,
- Early implementation of rain driven schedules for the Water Conservation Areas and Everglades National Park (Recommendation 27),

- Future CERP planning efforts need to consider wellfield configurations and performance evaluated in the LEC Plan as well as subsequent consumptive use permitting actions (Recommendation 28)

Recommendations for the CERP from the Caloosahatchee Water Management Plan

The following recommendations from the Caloosahatchee Water Management Plan are included here because they will provide insight into the implementation of CERP. They are:

- Recognition of the Conclusions of the Caloosahatchee Water Management Plan (Recommendation 29),
- Confirmation of the advisability of completing the Caloosahatchee ASR Pilot Project (Recommendation 30), the C-43 Storage Project (Recommendation 31) and the Southwest Florida Study (Recommendation 32).

Operational Strategies

Operational improvements and reevaluations are included in the CERP which call for the development of rain-driven environmental delivery formulas and the revision of operating procedures and protocols to reflect the completion of new facilities. The LEC Plan has identified three specific additional areas for improvements to operations that are needed for the next 5 to 10 years until the CERP features begin to come on line.

The incremental runs completed as part of the LEC Plan indicated that the frequency and severity of low Lake levels under the 1965 to 1995 climatic conditions would cause water supply problems for users dependent on Lake Okeechobee in the time frame through 2010. In this period it is, therefore, especially important that supply-side management policies be implemented in a flexible way to assure that the water in storage in each dry season is managed in the best way.

The first operational recommendation (Recommendation 33) is that the Lake Okeechobee Supply-Side management policy be reevaluated to incorporate operational flexibility to improve water supply performance while taking into account environmental goals and conditions. One example would be the fact that over the last six years, extreme wet periods have kept the lake abnormally high for long periods of time. Under such conditions, a drawdown of the Lake over the next several years would provide ecological benefits.

The second operational recommendation (Recommendation 34) is that operational priorities and protocols should be reevaluated on an annual basis and a specific strategy for each year presented for Governing Board approval.

The third operational recommendation (Recommendation 35) is that a Lake Okeechobee Vegetation Management Plan be developed so that detrimental environmental effects from lower Lake levels, primarily the spread of torpedo grass, melaleuca, can be effectively managed. The program would then be implemented whenever lower Lake levels dry the littoral zone.

Consumptive Use Permitting and Resource Protection

In this section descriptions of the general implementation legal and policy guidance are provided for the following specific implementation actions regarding reservations, minimum flows and levels recovery and prevention strategies, consumptive use permitting, water shortage program, and operational strategies.

Reservations of Water (Recommendation 36)

Table 46 identifies the water bodies where reservations will be adopted; the basis upon which the reservations of water will be derived (rainfall driven formula, salinity envelope criteria or STA minimum depth of water); as well as the targeted operation dates for water resource development projects providing for reservation water supplies.

These factors will be further refined through the reservation rulemaking and implementation process, including detailed design and feasibility analyses of associated water resource development projects. In addition to rule adoption of the reservations to set aside water quantities from allocation, operational protocols, for provision of phased increases in water quantities to these areas through 2020 will be developed. The following describes where establishment of reservations, and identification of associated implementation actions, are recommended:

A. Caloosahatchee and St. Lucie Estuaries: Reservations for these water bodies will be established for the purpose of providing freshwater inflows for preventing harm. Optimal salinity profiles and corresponding quantities of freshwater inflows, particularly during the dry season, have been identified in technical publications and integrated into the LEC regional model targets. Water reservations will identify water quantities for meeting these targets, for implementation when associated water resource development projects are implemented. Until water resource development projects making water available for meeting these reservations are operational, the District will utilize the annual process identifying operational actions to optimize water deliveries based on the projected annual conditions to meet these targets. The rulemaking for these reservations is projected to be completed by 2001.

B. STAs: Reservations for STAs will be adopted for the purpose of protecting fish and wildlife by maintaining water quality functions of the filter marsh and reducing the potential for nutrient releases associated with dry times. The reservation will include water quantities estimated to maintain at least.5 feet of water in the STAs to prevent dry out. Conditions on providing this water during droughts will also be identified, including conditions for making water deliveries from Lake Okeechobee with consideration given to

other water supply needs of the regional system, consistent with operations in the Everglades Construction Project Conceptual Design Document. Final rule adoption is projected for 2001.

C. Everglades National Park/WCAs: For the purposes of protecting fish and wildlife through restoration of hydropatterns as defined by the CERP (Restudy Final Alternative). Model results in the LEC plan also indicate water quantities delivered to these areas based on the incremental increased water availability during the next 20 years through water resource development. The reservation rule will account for these interim incremental increases through the next 20 years. Estimates on water quantities to be made available under the reservation, water resource development projects and operational protocol for providing these water quantities will be identified in the rule. Final rule adoption is projected for 2001.

D. Sub-regional Wetland Restorations: Reservations will be adopted for the purpose of protecting fish and wildlife in urban wetland systems slated for enhancement (Loxahatchee Slough, Pond Apple Slough, Fern Forest, Trade winds Park etc.) The District will work with Palm Beach and Broward counties to quantify the reservations, as well as identifying the sources of water when appropriate.

E. *Biscayne Bay/Florida Bay and Loxahatchee River:* For the purpose of protecting fish and wildlife through providing freshwater inflows that prevent harm. Research on the freshwater inflows to Florida Bay is scheduled to be completed by December 2002. The Florida Bay reservation rule will be adopted by December 2003.

F. Lake Okeechobee: Lake Okeechobee provides water storage for multiple purposes including consumptive uses of water and a number of water resource protection purposes. It will store and provide water for several reservations including the Everglades, STAs, Biscayne Aquifer and the St. Lucie/Caloosahatchee estuaries. However, the Lake has its own demand for water supplies to protect fish and wildlife as well. Therefore, the management of the Lake must address its function as a natural system as well as a water supply source. At the time of completion of this plan, a reservation proposed for the lake had not yet been quantified. It is recommended that the protection of the Lake's fish and wildlife be considered and the Lake reservation developed in concert with the reservations for the water bodies that rely on the Lake.

Following required research to support adoption of reservations for these areas, the district will proceed with identification of operational, regulatory and water resource development projects necessary to implement the reservations. This will also include integration of the reservations and implementation actions into regional water supply plan updates, five year water resource development plans and annual budgets.

Minimum Flows and Levels

Establishment of MFLs for Priority Water Bodies in the LEC (Recommendation 37)

Eight water bodies located within the LEC planning area have been identified as 'priority water bodies' within the District's Water Management Plan for the establishment of Minimum Flows and Levels (MFLs). The establishment of MFLs for four of these water bodies (Lake Okeechobee, the Everglades/WCAs, Biscayne aquifer, and the Caloosahatchee River) is scheduled for completion in 2000. Detailed descriptions of the basis for the MFLs are included in technical reports The recommended MFL criteria for each of these four water bodies used in the evaluation phase of the LECWSP are listed below. These recommended MFLs will under go rulemaking later this year.

Four additional water bodies; the Loxahatchee River, the St. Lucie Estuary, Florida Bay and Biscayne Bay are scheduled for MFL establishment in 2001, 2001, 2003, and 2004 respectively. Since the research necessary to define the MFL and restoration targets for each of these water bodies has not been completed, estimates were used as discussed below for performance measures in this round of the LECRWSP evaluation phase. These estimates will be replaced with the actual MFLs during the next five year LECRWSP update. In this process of developing the MFL rule, options for a recovery and prevention strategy will be explored and incorporated into future plan updates.

Finally, two additional water bodies are recommended for future establishment of MFLs and should be added to the priority water body list. These are Lake Worth Lagoon and southern coastal Biscayne Aquifer.

Lake Okeechobee Proposed MFL Criteria: See Chapter four for a description of this MFL.

Everglades/WCAs Proposed MFL Criteria: See Chapter four for a description of this MFL.

Biscayne Aquifer Proposed MFL Criteria: See Chapter four for a description of this MFL

Meeting Minimum Flow and Level for Caloosahatchee Estuary. The proposed Caloosahatchee MFL is based on maintaining freshwater base flows to the Caloosahatchee Estuary that would prevent excessive salinity levels from occurring in the upper reaches of the estuary. Research data were used to relate freshwater flow rates to salinity distributions along the Caloosahatchee River and to correlate biologic community responses to varying salinity distributions. These relationships were established for submerged aquatic vegetation, fish and invertebrates with major emphasis on the salinity requirements of the freshwater grass, *Vallisneria*. It was determined that the distribution and abundance of *Vallisneria* at a location 30 kilometers upstream of Shell Point is the best biological indicator for addressing freshwater flow needs for restoration of the

Caloosahatchee Estuary. The magnitude of die-off combined with the frequency of die-off events and the resulting impacts to fisheries resulting from the loss of *Vallisneria* habitat formed the basis of the proposed MFL criteria.

Low flows, when sustained, produce salinities which result in die off of tape grasses to less than 20 shoots per square meter measured at a monitor station located 30 kilometers upstream of Shell Point during the months of February through April. Significant harm to the Caloosahatchee Estuary is considered to occur when freshwater grasses die back due to high salinity from low freshwater inflows for three years in a row. Harm to the Caloosahatchee Estuary, the area in the C-43 between 28-30 kilometer marker, is considered to occur when freshwater grasses die back due to high salinity from low freshwater inflows, for two consecutive years. The freshwater inflow associated with preventing harm or significant harm is an average of 300 cfs per day at the S-79 structure during the months of February through April

Additional Research Needed to Support MFL Criteria for the Rockland Marl Marsh (Recommendation 38): . The majority of plant and animal communities that exist within the remaining Rockland marl marsh, located within and adjacent to Everglades National Park, has been severely impacted by overdrainage and development east of the Park. Studies of remaining communities have provided some limited information concerning the appropriate depth and duration of water levels needed to sustain their characteristic vegetation and wildlife communities. Current MFL targets proposed for this area are based on management targets developed as part of the Restudy/ CERP and LEC planning processes which are based on output of the Natural System Model (NSM).

It is the expert opinion of Everglades National Park staff that the NSM does not properly simulate hydrologic conditions within the Rockland marl marsh and that the interim MFL criteria may not sufficiently protect these wetlands from significant harm. Additional research is required to determine an appropriate return frequency for drought conditions that can be tolerated by both plant and animal populations without causing significant harm to their structure and function. Research on short hydroperiod, marl forming wetland plant and animal communities is needed to determine the distribution, extent, and structure of these communities within the historic Everglades; their historic and potential future role and significance as sources of food for wading birds and other vertebrates; and the seasonal dynamics of fish and macroinvertebrate populations, especially the amount of time that sustained high water levels are required to maintain ecosystem aquatic productivity.

As part of the LEC water supply planning process, the District, Everglades National Park, and USGS staff should jointly develop a work plan to conduct the necessary research needed to validate and/or refine the proposed MFL criteria, especially the return frequency component, for the Rockland marl marsh.

Establish MFLs for Florida Bay (Recommendation 39).. Findings of the MFL Scientific Peer Review Panel recommended the need to conduct a sufficiency review to examine existing surface and ground water data, especially data that illustrates the

relationship between upstream water levels and flows and their impact on downstream estuary and bay salinity levels. Based on this review, the District and other stakeholders should determine appropriate times frames and mechanisms for the establishment of MFL criteria for Florida Bay.

In response to the above recommendation, and requests made by Everglades National Park staff, Florida Bay was placed on the District's MFL Priority Water Body List for establishment in 2003. In addition, a formal MFL sufficiency review has been completed for Florida Bay and is currently under review by the Interagency Florida Bay Science Program and Everglades National Park staff. This sufficiency review presents an assessment of currently available technical information needed to develop MFL guidelines for Florida Bay. Florida Bay MFLs are defined as the minimum inputs of freshwater from the southern Everglades required to prevent significant harm to the Florida Bay ecosystem. Significant harm is defined as the loss of specific water resource functions that take multiple years to recover, which result from a change in surface water or ground water hydrology (SFWMD, 2000e).

Establishment of MFLs for Florida Bay is a challenging task because of the size, the spatial complexity of the estuary, and the diffuse nature of freshwater flow to the bay. The task requires an understanding of the physical and ecological characteristics of the bay and their sensitivity to fresh water inputs from the Everglades. By targeting a specific response variable (seagrass) that is critical to many other parts of the ecosystem (nutrient cycling, animals, other plants, water quality), the District expects to develop initial MFL technical criteria for Florida Bay by 2003. Conceptual models of Florida Bay are currently being developed for by the CERP Recovery Team to identify some of the more complex interactions within the ecosystem and may be used as a starting point to develop MFL criteria for Florida Bay.

As future research efforts provide additional information on some of these more complex ecological processes, subsequent refinement of the initial MFL criteria may be necessary. A number of research efforts are already under way with a second phase to be completed by 2006. An integrated Interagency Florida Bay Science Program, in which the District participates, has been collecting ecological information on the bay for the past three years. The databases and computer models that are products of this ongoing program will provide a foundation for developing MFL technical criteria.

An ecologically based MFL determination should include the following considerations:

- Salinity is the dominant factor that is affected by changing freshwater flows and levels.
- Salinity is a naturally varying characteristic of estuaries and MFLs must have criteria that incorporate seasonal and interannual variability.
- Water quality components other than salinity are also affected by changes in freshwater flow.

- The effects of salinity are not only direct, such as physiological stress on plants and animals, but also indirect, such as changing nutrient cycles, plant community structure, habitat availability, reproduction, and food webs.
- MFL determination depends on both bay and upstream watershed responses to these changing conditions as these subsystems are interconnected.
- Defining significant harm to the Florida Bay ecosystem requires identifying the main processes that sustain the Bay ecosystem and determination of the sensitivity of these processes to the establishment of MFL criteria.

A number of key data collection projects are currently underway, representing fruitful collaborations among federal, state, and university based scientists. However, most of the interagency projects were not specifically designed for determination of MFLs. Modifications of these projects, plus some additional research, will be needed to address specific MFL issues.

MFL Recovery and Prevention Strategies for Specific Water Bodies (Recommendation 40).

Pursuant to the requirements of the MFL statute, analyses of current and future conditions were conducted for each of the priority water bodies where MFLs were defined. When these evaluations showed that MFLs are not presently met, or will not be met in the future, recovery or prevention strategies are developed. Following are the MFL recovery/prevention strategies for the appropriate water bodies in the LEC planning area.

Lake Okeechobee: Analysis of the results of the 1995 Base run (BSRR) and the 2020 base run show MFL criteria were met. As a result, MFL exceedances are not expected to occur even if the LEC plan were not implemented. Therefore, neither a recovery or prevention strategy is required for Lake Okeechobee.

Caloosahatchee River: Analysis of both the 1995 and 2020 base case scenarios show the proposed MFL criteria for the estuary would be exceeded. Therefore, a recovery plan is necessary. Evaluation of the model results show that while the Caloosahatchee MFL was exceeded, there are sufficient quantities of water left in Lake Okeechobee to avoid significant harm to the estuary for ~~an~~ the interim period until the proposed long term regional storage facilities that comprise the recovery plan have been built. These regional storage facilities are recommended in the LECRWSP and CWMP, including ASR and regional surface water reservoirs.

Evaluations conducted in both the Restudy and the CWMP indicate that both MFL and minimum restoration flows (300 cfs during the spring) can be met through a combination of the construction of reservoirs, limited deliveries from Lake Okeechobee and from ASR systems located within the basin. Over the next five years, activities for

construction the regional facilities include implementation of the ASR pilot project, development of the Project Implementation Report (PIR) for the C-43 regional surface water reservoir, and completion of the SWF Feasibility Study. The scheduled time for completion of the reservoir is 2010 and for completion of the ASR project is 2015.

In the period of time prior to construction of these facilities, the District will utilize water in Lake Okeechobee when available for releases to the Caloosahatchee River estuary to prevent MFL violations, projected to occur only during extreme droughts. In implementing this interim prevention and recovery strategy, releases to prevent significant harm will occur as follows: If sea grass die back in the area identified in the MFL criteria occurs during one year, for at least one of the following two years, an average of 300 cfs of water will be delivered at S-79 during the months of February through April.

Everglades/WCAs: There are two general types of impacts (direct and indirect) that can occur within the Everglades/WCAs that can be attributed to consumptive use withdrawals. Indirect impacts occur as a result of making regional water deliveries to areas other than the Everglades. There are also direct impacts which can result from the pumping of adjacent well fields that lower the water table along the eastern edge of the Everglades system affecting wetlands located directly west of the north/south perimeter levee.

In an effort to define what areas of the Everglades may potentially be affected by existing and projected future water supply demands, District staff utilized the SFWMM to identify where the proposed MFL criteria are not met for the 1995 and 2020 base cases. Review of the 1995 base case showed the proposed Everglades MFL criteria were exceeded at 12 out of 19 locations (indicator regions) within the remaining Everglades system**.** Evaluation of the 2020 base case showed similar results, with no overall increase in the number sites that exceeded proposed MFL criteria compared to the 1995 base case. These results indicate that (a) a MFL recovery plan will be necessary for the 12 indicator regions identified in this modeling effort, and (b) some of the MFL exceedences identified were most likely caused by drainage impacts associated with construction and operation of the C&SF project, while other areas may have been affected by a consumptive use withdrawal. Additional modeling was needed to differentiate between these impacts.

The next step taken was to conduct additional modeling to determine what areas of the Everglades may be affected by consumptive use withdrawals. The following preliminary screening analysis was conducted to identify these areas. The SFWMM was rerun under two scenarios: (1) all LEC public water supply well fields turned on in the model, versus (2) all LEC public water supply well fields turned off in the model. Modeling results were evaluated using the set of environmental performance measures described in **Appendix D** of this report and are similar to those used in the CERP evaluation process.

Results of the “Pumps On/Pumps Off” scenario” revealed five indicator regions within the Everglades system that were potentially susceptible to large scale public water supply withdrawals as shown in **Table 51** below. With the well fields turned off, there were observed improvements in the number of MFL exceedences, improvements in

duration of flooding, and a reduction in the number of extreme low water events. These areas included (1) the Rockland Marl Marsh which reported a difference in annual flooding of 11%; (2) eastern WCA-3B (6% difference in annual flooding); (3) WCA-2B (5% difference in annual flooding); (4) Northeast Shark River Slough (3% difference in annual flooding), and (5) WCA-1 which showed an improvement in annual flooding (2%) as well as significant reduction in the number of MFL exceedences. These preliminary results suggest that these five areas of the Everglades system have the potential to be impacted by large-scale water supply withdrawals.

Table 51. Summary of LEC Water Utility Pumps On/Pumps Off Scenario for Selected Everglades Sites for the 2020 Base Case.[a]

Area	Gage	IR[b]	Number of Times MFL Criteria Exceeded	Inundation/Duration Summary			Number of Extreme low water events
				Number of Flooding Events	Duration (weeks)	Percent of Annual Flooding (difference)[c]	
Water Conservation Areas							
WCA-1	1-7	27	7/1	20/18	74/84	92/94 (2%)	5/1
WCA-2A	2A-17	24	8/7	18/16	80/92	90/92 (2%)	8/9
(WCA-2B	central	23	7/6	15/14	93/104	86/91 (5%)	8/6
Rotenberger	Rotts	28	22/22	38/38	34/34	79/79	20/20
Holey Land	HoleyG	29	5/5	11/11	140/140	96/96	5/5
WCA-3A (NW)	3A-NW	22	10/8	22/21	68/72	92/94 (2%)	8/6
WCA-3A (NE)	3A-NE	21	8/7	17/15	88/101	92/94 (2%)	9/8
WCA-3A (north)	3A-2	20	11/11	27/25	52/57	87/88 (1%)	10/8
WCA-3A (north)	3A-3	68	10/8	19/17	76/85	90/90	8/8
WCA-3A (central)	3A-4	17	10/10	25/24	57/59	88/88	9/9
WCA-3A (south)	3A-28	14	8/7	17/18	88/83	93/93	5/7
(WCA-3B	3B-SE	16	15/11	29/20	46/72	83/89 (6%)	19/12
Everglades National Park							
N.E. Shark Slough	NESRS-2	11	9/7	20/18	71/82	88/91 (3%)	9/10
Mid Shark Slough	NP-33	10	7/7	15/13	100/117	93/94 (1)	7/8
SW Shark Slough	NP-36	9	8/6	15/15	98/100	91/93 (2)	11/9
NW Shark Slough	NP-201	12	9/8	36/31	36/43	80/82 (2)	20/20
Rockland marl	G-1502	8	24/19	40/40	19/23	46/57 (11%)	31/25
Marl east SRS	NP-38	70	15/13	61/61	15/16	58/59 (1%)	NA
Taylor Slough	NP-67	1	16/16	38/36	30/32	71/72	28/28

a. First number in each box represents “Utility Pumps On” for 2020 Base Case, second number represent “Pumps Off”
b. IR = Indicator Region
c. Difference of values between the 2020 Base Case with utilities pumping and the 2020 Base Case without utilities pumping

Cutting off all public water supply wellfields was not considered practicable, due to the limited benefits to the system balanced with the impact of cutting off all public water supplies in the Lower East Coast. For these reasons, staff proceeded to model a

more realistic consumptive use withdrawal scenario that incorporates assumptions based on the District's current water shortage policy.

This modeling effort was basically a sensitivity analysis to identify the relative magnitude of impact that a 30% cutback in public water supply might have on the five areas identified above. The sensitivity analysis was conducted by running the SFWMM with (a) all LEC public water utilities pumps turned on; and (b) all LEC utilities turned on, except for Miami-Dade County which was cutback by a factor of 30% which is the level of cutback associated with Phase II water shortage restriction. The purpose of this analysis was to see if simply implementing a water shortage cutback could reduce the number of MFL exceedences and percent annual flooding. Modeling results were evaluated using the standard set of environmental performance measures developed for LECRWSP (Appendix D). These included review of (a) number of MFL exceedences over the 31-year simulation, (b) stage hydrographs and stage duration curves, (c) number of flooding events and their duration, (d) percent reduction or increase annual flooding, and (e) number of extreme high and low water events. Results are presented below in **Table 52** for year 2005 and **Table 53** for the year 2020..

Table 52. Model Simulation for Selected Everglades Sites[a]: 2005 versus 2005 with a 30 Percent Cutback in Public Water Supply Withdrawals for Miami-Dade County.[b]

Area	IR[c]	Number of times MFL Criterion Exceeded	Inundation/Duration Summary Table			Percent High Water Events	Number of Low Water Events	Average Duration Low Water (weeks)
			Number of Flood Events	Average Duration (weeks)	Percent Annual Flooding			
Water Conservation Areas								
WCA-1	27	5/5	21/21 (3)	71/71	92/92	5/5	4/4	3/3
WCA-2A	24	14/14	23/23	60/60	86/86	0/0	16/16	5/5
WCA-2B	23	16/16	25/24	48/50	74/74	23/22	21/21	9/9
WCA-3A NW	22	14/14	34/33	40/42	85/85	0/0	16/15	6/6
WCA-3A NE	21	12/12	17/17	83/83	87/87	3/3	12/12	6/6
WCA-3A central	17	8/8	17/17	88/88	93/93	5/5	8/7	4/4
WCA-3A south	14	1/2	10/8	158/198	98/98	19/17	1/0	1/0
WCA-3B (east)	16	10/10	21/19	68/76	88/90 (2%)	5/5	13/12	4/3
Everglades National Park								
Rockland marl	8	21/20	35/37	27/26	58/60 (2%)	0/0	26/27	13/12
NE Shark Slough	11	11/11	23/20	61/72	87/89 (2%)	14/13	12/11	6/6
Mid-Shark Slough	10	11/11	22/22	66/66	90/90	2/2	12/13	5/5
SW Shark Slough	9	10/10	20/21	71/68	89/89	0/0	16/16	4/4
C-111 Perrine Marl	4	NA	81/79	10/10	49/50 (1%)	0/0	43/48	34/30
Mid-Perrine marl	3	NA	48/48	18/18	52/53 (1%)	0/0	31/28	4/4
Taylor Slough	1	16/16	38/38	30/30	71/72 (1%)	1/1	27/27	4/4

a. Sites were selected based on their potential for impact by a LEC wellfield withdrawal.
b. The left hand number in each box represents the 2005 incremental simulation with all LEC utility pumps on; right hand number represents the 2005 incremental simulation with a year round 30 percent reduction in public water supply for Miami-Dade County.
c. IR = Indicator Region

Table 53. Model Simulation for Selected Everglades Sites[a]: 2005 versus 2005 with a 30 Percent Cutback in Public Water Supply Withdrawals for Miami-Dade County.[b]

Area	IR[c]	Number of times MFL Criterion Exceeded	Inundation/Duration Summary Table			Percent High Water Events	Number of Low Water Events	Average Duration Low Water (weeks)
			Number of Flood Events	Average Duration (weeks)	Percent Annual Flooding			
Water Conservation Areas								
WCA-1	27	1/1	12/12 (3)	129/129	96/96	7/7	1/1	1/1
WCA-2A	24	8/8	13/13	112/112	91/91	5/5	11/11	6/6
WCA-2B	23	8/8	19/18	71/75	83/84 (1%)	21/22	12/12	8/7
WCA-3A NW	22	6/5	27/20	56/76	94/95 (1%)	0/0	4/4	4/3
WCA-3A NE	21	15/14	26/26	52/52	83/84 (1%)	7/7	17/19	5/4
WCA-3A central	17	4/4	16/16	96/96	95/96 (1%)	2/2	5/5	3/3
WCA-3A south	14	4/5	11/12	140/128	95/95	3/3	4/4	3/3
WCA-3B (east)	16	3/3	10/10	154/155	96/96	13/16	3/3	3/2
Everglades National Park								
Rockland marl	8	22/20	38/39	23/24	55/58(3%)	0/0	28/25	10/10
NE Shark Slough	11	2/2	15/11	105/143	97/98 (1%)	8/10	2/3	3/2
Mid-Shark Slough	10	2/2	9/10	175/158	98/98	3/3	2/2	3/2
SW Shark Slough	9	4/4	15/13	103/119	96/96	0/0	6/5	2/2
C-111 Perrine Marl	4	NA	45/42	27/29	76/76	11/11	49/48	18/18
Mid-Perrine marl	3	NA	50/48	17/18	52/54 (2%)	0/0	34/33	4/4
Taylor Slough	1	16/16	37/36	31/32	71/71	5/5	28/28	4/4

a. Sites were selected based on their potential for impact by a LEC wellfield withdrawal.
b. The left hand number in each box represents the 2005 incremental simulation with all LEC utility pumps on; right hand number represents the 2005 incremental simulation with a year round 30 percent reduction in public water supply for Miami-Dade County.
c. IR = Indicator Region

Left hand number in each box represents the 2020 simulation with all LEC utility pumps on; right hand number represents the 2020 simulation with a year round 30% reduction in public water supply for Miami-Dade County.

2005 with a 30 Percent Cutback. For 2005, three areas were identified that showed hydrologic differences between the two modeling scenarios. These areas included: (1) the Rockland marl marsh located with ENP (indicator region 8), (2) Northeast Shark River Slough (indicator region 11) also located in ENP, and (3) southeast WCA-3B (indicator region 16). All three of these sites are located within the extreme western portion of Miami-Dade County (**Table 52**).

Review of stage hydrographs and stage duration curves for each of these three sites showed very minor differences in performance between the pumps on and the 30% cutback modeling scenarios. Differences in performance between the two model runs were small and included: (a) a 2% improvement in hydroperiod (annual flooding), (b) a small increase the number of continuos flooding events, and (c) a decrease in the number of MFL violations for the Rockland marl marsh recorded under the 30% cutback scenario (**Table 52**). The improvements identified under the 30% cutback scenario are very close to

or within the assumed confidence limits of the SFWMM and therefore may not be significant.

It should also be noted that this modeling scenario implements a 30% cutback for Miami- Dade County year round for the 31-year simulation. It is unlikely the District would impose a 30% cutback in public water supply for Miami-Dade County during wet periods or under normal rainfall conditions. The only time a 30% cutback would actually be in effect would be during a major drought period. Therefore, observed impacts or improvements to Everglades wetland hydrology observed under the 30% cutback scenario would more than likely be considerably less than those shown in **Table 52**.

The 2020 Model Run with a 30 Percent Cutback. By year 2020 most of the CERP water supply and natural system restoration projects would be built and in place. Comparison of the pumps on and the 30% cutback scenario show only two areas as reporting hydrologic differences by 2020. These areas include (1) the Rockland marl marsh (indicator region 8), and Mid-Perrine marl marsh (indicator region 3) each located within eastern portion of Everglades National Park (**Table 53**).

The largest difference recorded is within the Rockland marl marsh where a 3% improvement in hydroperiod (average annual flooding) was observed under the 30% cutback scenario (**Table 53**). In addition, there is a small decrease in the number of MFL violations for the Rockland marl marsh observed under the 30% cutback scenario. In the Mid-Perrine marl marsh there is a 2% improvement in hydroperiod and a small increase in the number of continuos flooding events when the 30% cutback was imposed as shown in **(Table 53)**. Again, these results are close the confidence limits of the SFWMM. It is also unlikely the District would impose a 30% year round cutback in public water supply for Miami-Dade County. Therefore, the observed differences between model runs would more than likely be less than those presented in **Table 53** below.

The result of the cutbacks did not show a significant reduction in the number of MFL violations, suggesting that a 30% cutback would not be effective in improving the MFL performance in the Everglades. As a result, the recommended MFL recovery program for the Everglades does not incorporate cutbacks of consumptive use permits.

The District's current consumptive use permit criteria prohibits the issuance of permits that would cause harm to the water resources. As a result, in areas where the MFLs are being exceeded (significant harm occurring), no consumptive use permits could be issued that would cause an additional drawdown under 1 in 10 level of certainty. Consumptive uses that would cause an increase in the number of MFL exceedences within the Everglades would not be permittable.

As a result, the main component of the MFL recovery plan for the Everglades is the construction and operation of the CERP and LECRWSP projects slated for completion between 2010 and 2020. In the interim, the plan shall recommend that the District conduct an annual assessment of the availability of water supply in regional storage available for releases to prevent MFL exceedences. To the degree practicable, the Governing Board shall authorize staff to make releases to prevent violations of the proposed MFL criteria.

Biscayne Aquifer: Identified measures for prevention of MFL exceedances are: 1) Maintain coastal canal stages at the minimum operation levels shown in the MFL report. 2) Implement CUP condition for issuance to prevent harmful movement of saltwater intrusion up to a 1 in 10 year drought condition; 3) Maintain a groundwater monitoring network and utilize data to initiate water shortage cutbacks should the threat of saline water movement become imminent, and 4) Conduct research in high risk areas to identify where the position of the saltwater front is adjacent to existing and future potable water sources.

Establish MFL Monitoring Systems (Recommendation 41)

A final MFL need is for monitoring systems to be established to assist with the implementation of MFLs and with the refinement of MFL criteria.

Resource Protection and Water Allocation Rulemaking for CUP Implementation (Recommendation 42)

The following are specific rule provisions necessary for implementation of the regulatory program, consistent with both the regional water supply plan and localized resource protection standards.

Level of Certainty

Define by rule the level of assurance provided to consumptive users and the environment that water will be available to meet the reasonable demands up to specific hydrologic conditions. The allocation methodologies and impact evaluations will be modified to reflect the 1-in-10 year level of certainty planning goal derived in the water supply plan. For the purposes of determining allocation and evaluating the impacts of an allocation, the proposed rules will define 1-in-10 rainfall conditions across the entire district utilizing statistical methods and historic rainfall data (See appendix).

Permit Duration:

Section 373.236, F.S., Duration of Permits states in relevant part:

> "Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided."

The district will define by rule the conditions for issuance of 20 year permits, and permits for lesser durations, including when sufficient information exists to provide reasonable assurances that the use will continue to meet the initial conditions for issuance pursuant to Section 373.239, F.S. This will incorporate phased increases in allocations to meet increasing reasonable beneficial uses incrementally with implementation of water resource development projects as recommended in the water supply plan.

A conceptual framework for implementing the permit duration statute has been set forth by District staff, which will be further refined in the rule development and rule making processes. Under this framework, there are two basic permit duration scenarios: 1) Duration of permits for which renewal is requested from a source that has been identified to continue to be available for the planning horizon will be 20 years. 2) Duration of permits for use of sources where water availability to meet the requested reasonable-beneficial demands is dependent upon future water resource development, including augmentation to meet current and increased user demands, will be determined as follows: a) The water quantity initially available (from 2000 through 2005), will be allocated to meet initial demands of consumptive uses will be allocated for a 20 year period; b) When additional water allocations from the source are requested to meet increasing demands, additional water made available through water resource development and other measures will be allocated in five year increments. Permit modification will be required to receive allocation for these increased demands, and will extend for 20 year periods.

Saltwater Intrusion Criteria

Define hydrologic conditions under which harmful saline water intrusion will not occur as a result of cumulative existing and proposed consumptive use withdrawals during a 1 in `10 year drought. Existing water resource protection criteria for saltwater intrusion will remain and an additional method of analysis (flow vector analysis for net inflow over a 1 in 10 year drought) will be added. The vector analysis will be reflective of the evaluation conducted under the LECRWSP. In this process, the rules will be amended to require the applicant to measure the magnitude of groundwater flow across the 250 mg/l isochlor (saltwater/freshwater interface), assuming the maximum annual allocation withdrawal simulated during a 1 in 10 year drought event. For uses in which the net flow across the interface is either eastward or zero for the drought event, the saltwater criteria will be met. Projects that produce a net westward flow of saline water will be denied.

Wetlands and Other Surface Waters Protection

Numeric drawdown criteria for defining hydrologic conditions under which harm to the water resource functions to wetlands and other surface waters is projected to occur has been under development for the last several years. These criteria will be finalized for evaluation of the potential drawdown impacts of cumulative existing and proposed consumptive use withdrawals during a 1 in 10 year drought. Criteria differentiating wetland types according to hydrologic characteristics will also be proposed. Special factors for consideration in the hydrologic impact analysis, such as listed species utilization in wetland areas, will be incorporated into the rule. Requirements for avoidance and minimization of harmful consumptive use impacts will be identified. In addition, circumstances for use of mitigation to offset projected harmful impacts will be explored for inclusion in the rule, consistent with Department of Environmental Protection policy direction on this issue. Finally, public interest considerations for identifying circumstances when application of proposed wetland drawdown parameters would cause undue hardship, inconsistent with Section 373.223, F.S, conditions for permit issuance, will be explored and considered for adoption, as appropriate.

Permit Renewal Process

Identify the timing of and process for the renewal of consumptive use permits. Staff contemplates a four year renewal process, in the following order of planning areas: Upper East Coast, Lower West Coast, Lower East Coast, Kissimmee Basin. In the interim period public water supply permit durations will be linked to the date identified for renewal of irrigation permits.

Regional Water Availability Criteria

The consumptive use permitting program contains water resource rules against harmful withdrawals without analyzing the regional cumulative impact of allocating water from the Central and Southern Florida Flood Control Project, as a source of either surface or groundwater (induced seepage under the levees). Up to now, this approach was considered adequate for protecting the water resources from harm. However, now that minimum flows and levels criteria and Everglades Protection area restoration projects are being implemented, along with the potential for increasing human demands from the regional system, regional criteria must be developed to assess water availability for allocation and environmental demands from the regional system.

The LEC preferred alternative (LEC 1) estimates the amounts of water available for each service area upon implementation of the regional water supply plan over the next 20 years. The model evaluations conducted for the interim periods (2005, 2010, 2015, 2020) define the incremental availability of water to each county (Palm Beach, Dade and Broward) and for the upper and lower Indian Prairie/Istokpoga Basin) from the regional system during 1 in 10 drought conditions (from groundwater seepage and surface water flows, as appropriate).

Improved Pasture Irrigation

Current allocation criteria for improved pasture irrigation is based on a volume of water needed to irrigate turf grass using a seepage irrigation method. The supplemental irrigation requirement in the existing Basis of Review for Consumptive Use Permit Applications, is based in demands during a moderate drought condition, which would not be expected to occur once every five years. It is projected that the actual use of water for improved pasture, versus that allocated under permit, is considerably below what this current allocation criteria allows. As a result, it is recommended that such criteria be revised to more accurately reflect actual irrigation practices and the amount of water necessary for pasture irrigation.

Water Shortage Plan

The District will develop and adopt water shortage triggers to avoid causing significant harm to water resources, in conjunction with the implementation of the District's Water Shortage Plan (Chapter 40E-21, F.A.C.). Water shortage triggers to implement natural system protection and water supply source protection have been identified in the planning process and integrated into the LEC 1.

Resource protection criteria are designed to prevent harm to the resources up to an 1-in-10 drought event. For drought conditions greater than a 1-in-10 event, it may be necessary to decrease water withdrawals to avoid causing significant or serious harm to the resource. Water shortage triggers, or water levels at which phased restrictions will be declared, are used to curtail withdrawals by water use types to avoid water levels declining to a minimum level where significant harm to the resource could potentially occur.

Water shortage rule revisions will include language which addresses the conditions by which cutbacks to rainfall based water reservations would be required. Staff recommends that no mandatory cutbacks occur to the natural system's water reservations during Phase I to Phase III water shortages unless specifically ordered by the Governing Board, after consideration of conditions on a case-by case basis.

Even though water shortage triggers will be established, a case-by-case analysis for a given drought circumstance will continue to exist. Thus, prior to declaring a water shortage, the District will also analyze the factors listed in the Water Shortage Plan concerning such issues as: (1) whether or not sufficient water will be available to meet the estimated and anticipated user demands; and, (2) whether serious harm to the water resource will occur.

Special Areas Designations

Two special designations contained in the Water Use Permitting Program were reviewed based on the findings of this planning effort. Definitions of the designations and recommended changes, if any, are provided below.

a. Reduced Threshold Areas.

Reduced threshold areas (RTAs) are areas of the District where the volume of usage delineating a general permit from an individual permit has been reduced from 100,000 gallons per day (GPD) to 10,000 GPD average day demand. RTAs have typically been designated in resource depleted areas where there is an established history of substandard water quality, saline water movement or the lack of water availability to meet the projected needs of a region. Results of the LEC Water Supply Plan and increased impact analysis capabilities did not indicate significant potential problems. Assessment determinations are conducted for all consumptive use applications. For withdrawals less than 100,000 gpd, qualifying for a general permit versus an individual permit will be based on the potential cumulative impacts of the use.

b.Water Resource Caution Areas.

These areas were formerly referred to as Critical Water Supply Problem Areas and are described in Chapter 40E-23, F.A.C. Water Resource Caution Areas (WRCAs) are defined as areas that have existing water resource problems or areas in which water resource problems are projected to develop over the next 20 years. Diversification of supply sources is currently occurring within some of areas and it is anticipated these areas will change designation in the future once sufficient diversification has been realized.

Water resource caution area boundaries will be redefined in the LWC pursuant to the results of the water supply plan analyses and evaluation. No changes in the boundaries in the LEC or Kissimmee planning areas are contemplated.

Reuse of Reclaimed Water

Legislation enacted in 1994 requires all water management districts to adopt reclaimed water rules that address use of water from other sources in emergency situation or when reclaimed water is unavailable. These rules are to be adopted for the implementation in the upcoming permit renewal process. In addition, existing rules regarding reuse feasibility will be considered for adoption.

Diversion and Impoundment

Identify allocation criteria for diversion and impoundment uses classes. Criteria developed for allocation will consider efficiency in surface water delivery systems and recycling of water between crops. The allocation criteria will be applicable to principally agricultural related systems.

Cup Model Applications

Modify groundwater planning models for the LWC and LEC for application in determining individual impacts of CUP applications. Rule changes identifying application of models in the CUP review process will be adopted, as appropriate.

Aquifer Storage and Recovery Permitting

Projects that involve diverting surface or ground water for storage underground must address the potential impacts of the use with regard to water resource protection and existing legal user protection. Prior to injecting the fresh water underground for storage, the applicant will be provided to demonstrate that the fresh water stored will be protected from other users. Other users of the Floridan Aquifer System will seek assurances that the storage of fresh water and the resulting changes in the water chemistry and hydrostatic pressure within the aquifer will not be harmful to their proposed use. The ASR rule will address the impacts of initial diversion of water, the reasonable quantities necessary for the project, the impacts of injection on other existing legal users, the impacts of the withdrawals of water from storage in other existing legal user ASR projects, and interference caused by intermingling of water of differing water qualities on other uses.

BMP Makeup Water Rule Revisions

Previously, it had been estimated the implementation of best management practices in the EAA would reduce the volume of runoff available to be sent south into the Everglades by 20%. Since this rule was implemented in 1995, data collected and evaluated suggests that there is minimal reduction in runoff from the EAA due to BMP implementation. Therefore, it is recommended that the current BMP makeup water rule be revisited through a public rulemaking process to incorporate this new information

Additional Water Resource Projects

This section includes a water conservation program. Also, through the LECWSP process and the Integrated Water Management Planning processes, several evaluation and feasibility projects have been identified which will be completed and used in the formulation of the next update of the LECRWSP, which will be completed by 2005 and cover a twenty year planning period through 2025.

Conservation (Recommendation 43)

While implementation of conservation measures by individual users is a water supply development activity, there is a key need and opportunity to evaluate and support these efforts from a water resource development standpoint. There are existing federal, state and SFWMD water conservation regulations and programs. The impacts of these programs have been evaluated differently in different planning efforts. For example, in the Restudy significant reductions in per capita consumption were expected between 1995 and 2020 while in the *LEC Regional Water Supply Plan* the projected per capita consumption increases slightly between 1995 and 2020. The identified need is for a program which will both evaluate the implementation of the existing conservation regulations and programs and conduct outreach to assure that all conservation opportunities are being implemented.

Seawater Reverse Osmosis Treatment Facilities (Recommendation 44)

Recently Tampa Bay Water approved a plant to obtain water from seawater by direct osmosis treatment. Proposed costs were significantly lower than other seawater desalination costs to date and apparently reflect energy and disposal cost reductions due to the co-location of the plant with an existing coastal power plant. This project will evaluate the feasibility of colocating similarly designed plants at existing power plants in the LEC Planning Area. The feasibility studies will seek to determine the likelihood that the large cost reductions estimated for the Tampa plant are achievable. The SFWMD is initiating the feasibility study during the present fiscal year (2000).

There are significant water resource development implications to obtaining treated seawater much more cheaply than has previously been experienced. Taking into account the savings in conventional water treatment costs, there may be significant net savings from using seawater reverse osmosis treatment facilities compared to proposed CERP projects, such as the Wastewater Reuse Facilities in Miami-Dade County, in capturing or providing additional water.

Northern Palm Beach County Reclaimed Water Irrigation System (Recommendation 45)

This project will evaluate the feasibility of developing a regional irrigation water system for northern Palm Beach County and Martin County utilizing reclaimed water from Central Palm Beach County. Not only would this help meet future needs for irrigation water but it would help recharge coastal aquifers, lessening saltwater intrusion

threats, potential impacts on wetlands and movement of existing pollutant plumes. It would also lessen the dependency of wastewater utilities on deep well disposal, which may encounter regulatory difficulties. The evaluation of this system will have to be coordinated with the CERP projects planned for this area.

Indirect Aquifer Recharge (Recommendation 46)

Large amounts of secondarily treated wastewater are generated by wastewater utilities in the Lower East Coast. While, programs to promote and encourage reuse have been in effect for many years, the amount of reuse has remained small relative to the water potentially available. This project will examine ways in which reuse of reclaimed water can be increased in a way that assures that the reuse systems provide contributions to meeting water supply and environmental restoration goals that are commensurate with the additional costs that will be incurred.

Four wastewater reuse facilities are included in the CERP process. The two largest projects are located Miami-Dade County and together they will provide by 2020 about 200,000 acre feet of advanced treated water to recharge the coastal canals and aquifer in Miami-Dade County. There are also two projects in Palm Beach County. The Palm Beach County Wetlands-Based Water Reclamation Project will take advanced treated water which will be further treated in a series of rehydrated marshes and eventually used to recharge wellfields and other areas. The other Palm Beach County project, Winsburg Farm Constructed Wetland, will use the reclaimed water to hydrate 175 acres of constructed wetlands. The efforts of the indirect aquifer recharge project will need to focus on issues not covered in these related CERP projects.

High Volume Surface Water ASR Testing/Taylor Creek (Recommendation 47)

An opportunity may exist to utilize the District-owned ASR well located by Taylor Creek in Okeechobee County to test the practicality of using injection/recovery rates of 20 MGD into a prolific zone of the Floridan aquifer. Permit and well repair issues need to be resolved as part of this effort.

WATER SUPPLY DEVELOPMENT OPTIONS

Water supply development options (Recommendation 48) are discussed below in terms of the water sources on which they will rely. These sources are:

- Conservation
- Groundwater (including the Biscayne/Surficial Aquifer System and the Floridan Aquifer System)
- Reclaimed Water
- Seawater Desalination

- Storage (including Aquifer Storage and Recovery and Reservoirs)
- Surface Water Sources

Water supply options which utilize each water source are discussed below with regard to their potential for use in the LEC Planning Area. For each option, the following information is presented: definition and discussion, estimated costs to develop that option and the quantity of water potentially available from that option, In addition, conclusions regarding the potential of the water supply options which use each water source. This information is provided so that individual water users can better evaluate alternative water supply sources and select the alternative, or combination of alternatives, which best suits local conditions. That the water users conduct such an evaluation is the substance of Recommendation 48 in Chapter 6,.

Conservation

Definition and Discussion

This option incorporates water conservation measures that address water demand reduction and capture of water that would otherwise be discharged to tide, including practices that achieve long-term permanent reductions in water use. Establishing a water conservation goal or conservation ethic was discussed when goals and objectives were first considered for this plan. The spirit of water conservation is captured in the following LECRWSP Objectives:

- Protect and conserve the water resources of South Florida to ensure their availability for future generations
- Provide for the equitable, orderly, cost-effective and economical development of water supplies to meet South Florida's environmental, agricultural, urban, and industrial needs

The committee further discussed whether advanced levels of water conservation should be implemented beyond current mandatory requirements regardless of the cost, or whether advanced levels should be considered as a tool or source option to be evaluated with other source options to meet the water needs of a particular area.

Mandatory Requirements

In 1988, The District began working with utilities to implement a conservation program through the Consumptive Use Permitting process. In 1991 the Program was incorporated by rule and became part of the permitting process. The water conservation plans must incorporate specific elements depending on the type of use. For public water suppliers the elements are: an irrigation hours ordinance, a Xeriscape landscape ordinance, an ultra-low volume fixture ordinance, a rain sensor device ordinance, a water conservation-based rate structure, a leak detection and repair program, a public education program, and a reclaimed water feasibility evaluation. For commercial/industrial users the

requirements include a water use audit, an employee water conservation awareness program and implementation of cost-effective conservation measures. For landscape and golf course users the requirements are Xeriscape landscaping, the use of rain sensor devices, and irrigation hour limitations) For agricultural users the requirement is that micro-irrigation systems be used for new citrus and container nursery projects. In addition to these CUP requirements, conservation requirements are also incorporated in Recommended Orders for Developments of Regional Impact (DRI).

Depending on the demographics and location of the service area, utilities can choose to demonstrate which water conservation activities are more cost-effective for their situation and emphasize implementation of those activities in their conservation plan. Four of the mandatory water conservation elements require adoption of an ordinance by local governments. Generally, because of the home rule autonomy of local governments, each ordinance has to be adopted by each unit of local government for the measure to be fully implemented. Investor owned utilities (private) do not have the authority to pass ordinances, so they must request the adoption of appropriate ordinances by local governments who have jurisdiction in that utility's service area. Utilities are not required to have a leak detection program if their unaccounted for water is less than 10 percent. An integrated program between the CUP and local ordinances is created when local governments have adopted the ordinances and established a compliance program.

In the period from 1988, when these requirements were first implemented, to 1995 substantial reductions in per capita consumption of about 13% were achieved by water utilities and their customers. This reduction in per capita use translates to a savings of approximately 118 MGD for the utilities listed in **Table 54**. This evaluation compares the actual water use against permanent populations of the service areas for utilities which use over 4 billion gallons per year. Some utilities were excluded from the evaluation because of changes in treatment efficiency and for other statistical and data availability reasons. Since these reductions are incorporated in the 1995 base usage, the relevant issue for the LEC Plan is the additional conservation that can be achieved.

Supplemental Measures

There are also several supplemental water conservation measures that local users could implement if they deem any of the measures to be cost effective. Measures for urban users include indoor and outdoor retrofits and landscape audit and retrofit; public water supply utilities include filter backwash recycling and distribution pressure control; and agricultural users include irrigation audits and improved scheduling, and retrofitting with a micro-irrigation system.

Mobile Irrigation Labs

A conservation program implemented in several areas of the District, with District financial support, are Mobile irrigation labs (MIL). Any particular lab is usually identified as agricultural MIL or urban MIL. Urban labs typically serve landowners with less than 10 acres of irrigated lands. These labs conduct performance evaluations for both agricultural and urban irrigation systems free of charge as a public service. The MIL program helps to

Table 54. Changes in Per Capita Water Use for Larger Utilities in the District.

	1988			1992			1995			Percent Decrease
UTILITY	MGD	Pop.	PCUR	MGD	Pop.	PCUR	MGD	Pop.	PCUR	PCUR 1988-1995
Miami-Dade Water and Sewer Dep	152.8	715000	214	168	810000	207	168.2	933000	180	16%
Miami Dade Water and Sewer Dep	153.6	790000	194	158.1	824000	192	166.8	852000	196	-1%
Orlando Utilities Commission	67.25	309800	217	74.6	339700	220	78.48	353300	222	-2%
Fort Lauderdale, City Of	54.71	215300	254	50.2	227000	221	48.7	230000	212	17%
Palm Beach County Water Utilit	24.54	210000	117	32.45	261600	124	33.7	282500	119	-2%
Boca Raton City Of	45	97700	461	36.85	109800	336	35.91	116900	307	33%
West Palm Beach City Of - Depa										
Kissimmee, City Of	5.44	60000	91	12.1	99900	121	13.55	125200	108	-19%
Cape Coral, City Of	8.8	37600	234	10	68400	146	8.66	77200	112	52%
Jupiter, Town Of										
Sunrise, City Of	13.94	107100	130	15.77	129200	122	18.1	141800	128	2%
Reedy Creek Improvement Distri										
Collier County Water Sewer Dis	4.08	21400	191	12.1	66900	181	16.85	86400	195	-2%
Hollywood, City Of	20.2	128300	157	18.9	140300	135	19.3	140700	137	13%
Seacoast Utility Authority	14	56600	247	13.9	71300	195	13.9	72000	193	22%
Pompano Beach, City Of	18.83	83300	226	16.25	73000	223	16.23	74000	219	3%
Naples City Of	18.37	49600	370	16.25	53174	306	15.81	55600	284	23%
North Miami Beach City Of										
Broward County Office Of Envir										
Plantation, City Of	10	59300	169	12.3	67500	182	13.9	73600	189	-12%
Delray Beach, City Of	11.2	60400	185	12.16	63100	193	12.13	65300	186	0%
Florida Keys Aqueduct Authorit	13.2	129500	102	12.99	139100	93	14.08	144300	98	4%
Orange County Public Utilities	3.59	17500	205	5.29	35700	148	6.94	43900	158	23%
Boynton Beach, City Of	10.97	68000	161	12.14	83786	145	12.78	89800	142	12%
Pembroke Pines, City Of	6.1	59000	103	7.44	70100	106	9.33	87900	106	-3%
Collier County Utlities Divisi										
Lee County Board Of Commission	8.17	64800	126	8.53	83700	102	8.58	90435	95	25%
Homestead, City Of	6.96	30400	229	6.1	30100	203	6.47	32300	200	13%
Deerfield Beach, City Of	10.85	51800	209	10.76	54800	196	11.3	56900	199	5%
Fort Myers, City Of										
Broward County	13.97	65200	214	13.65	87700	156	14.55	91900	158	26%
Fort Pierce Utilities Authorit	8.52	52000	164	9.29	56400	165	9.3	58600	159	3%
Average			**199**			**177**			**172**	**13%**
Totals	**705.09**	**3539600**		**746.12**	**4046260**		**773.55**	**4375535**		

develop a conservation ethic among water users while providing practical advise on how to achieve significant water savings.

There are currently two MILs in the LEC Planning Area, serving Miami-Dade and Palm Beach Counties. An agricultural lab is headquartered at the South Dade SWCS Office in Homestead and serves Miami-Dade County. This lab also performs some urban evaluations. The other lab is headquartered at the SWCS Office in West Palm Beach and performs urban evaluations in Palm Beach County. Funding for these labs has been provided by the District and the Natural Resource Conservation Service (NRCS). However, recent decisions by the Governing Board related to CERP funding have indicated that this is not a core program for funding by the SFWMD. As a result SFWMD participation in funding will be limited to providing staff to garner support form other agencies such as DEP, DACS and Soil and Water Conservation Districts as well as users.

The annual operating cost for an urban MIL is approximately $70,000 and $130,000 for an agriculture MIL. Both of these labs are working near their capacity in terms of the number of evaluations that can be performed in a year. As a result, it is recommended that an additional urban MIL should be established at the Broward County SWCD to serve the Fort Lauderdale area. Dedicated sources of funding need to be established for the existing, as well as, the recommended MILs.

Cost-Effectiveness Analysis from the FY 1998 MIL Program. The costs and potential water savings contained in the 1998 annual reports. Typical values for urban and agricultural MILs such as those in Palm Beach and Miami-Dade counties are presented in **Table 55.**

Table 55. 1998 Mobile Irrigation Lab Costs and Estimated Water Savings.

Lab	Annual Cost	Potential Savings (1,000 gallons per year)	Total Cost (per 1,000 gallons)
Urban	$70,000	79,500	$.88
Agriculture	$130,000	1,470,000	$.09
Total	$200,000	1,549,500	$.13

The costs per 1,000 gallons saved compare favorably with alternative source development. This cost-effectiveness will be magnified to the degree that cost-savings from a single mobile lab visit extend over several years. Another environmental benefit of the urban and agricultural mobile lab program is the reduction of pollution from fertilizers and pesticides applied to urban landscapes and cropland. One of the key components of the MIL program, education, is not illustrated in the above tables.

Conservation Estimated Costs

The information in this section should not be interpreted as a benefit-cost analysis of these conservation measures, since no discounting is applied to the streams of cost and benefits.

Urban Conservation Measures. Cost and water savings for several indoor and outdoor urban retrofit water conservation measures are provided in **Tables 56** and **57.**

Table 56. Representative Water Use and Cost Analysis for Retrofit Indoor Water Conservation Measures.

	Toilet	Showerhead
Cost/unit	$200	$20
Flushes/day/person	5	--
Gallons saved/flush	1.9	--
Minutes/day/person	--	10
Gallons saved/minute	--	2
Persons/unit	2.5	2.5
Life	40 years	10 years
Savings/year/unit	8,670 gallons	9,125 gallons
Savings/unit over life	346,800 gallons	91,250 gallons
Cost/1,000 gallons saved	$0.58	$0.22
Gallons saved/dollar invested	1,730 gallons	4,560 gallons

Table 57. Representative Water Use and Cost Analysis for Retrofit Outdoor Water Conservation Measures.[a]

	Rain Switch
Cost/unit or visit	$68
Acres/unit	0.11 acres
Water savings (inches/year)	70 inches
Water savings (gallons/year)	209,070 gallons
Life	10 years
Water savings/life	2,090,700 gallons
Cost/1,000 gallons saved	$0.033
Gallons saved/dollar invested	30,750 gallons

a. Represents additional cost of site visit (currently compensated by NRCS and the District).

For urban water conservation methods, the analysis indicated the value of the savings is greater than the costs of the methods. The savings per unit of cost associated with outdoor conservation measures are generally greater than those for indoor conservation measures, primarily because of the larger volumes of water involved. Water savings associated with implementation of retrofit programs can be significant. For example, retrofitting 10,000 showerheads in an area could result in a water savings of 182 MGY (0.50 MGD). Likewise, if 10,000 irrigation systems were retrofitted with rain switches, the water savings could be more than 2,000 MGY (5.73 MGD). One potential urban conservation method is for local governments to adopt ordinances limiting the number of days per week a home can irrigate. Such ordinances may achieve the same results as a rain- switch retrofit program at significantly less cost.

Agricultural Conservation Methods. Conversion of existing flood-irrigated citrus to micro-irrigation is another potential source of water savings (**Table 58**). It is estimated by UF-IFAS that the initial cost to install a micro-irrigation system on citrus is $1,000 per acre and the system would have estimated annual maintenance costs of $25 per year (IFAS, 1993). The table summarizes the cost and potential water savings from one acre of conversion. This comparison used the modified Blanney-Criddle formula, and the only variable that changed between the two scenarios was the efficiency factor. Return flow for flood irrigation was not accounted for. The water savings from converting 25,000 acres of citrus from flood irrigation with a 50 percent efficiency to micro-irrigation with an 85 percent efficiency could result in a water savings of approximately 6,000 MGY (15.8 MGD). The analysis illustrates that given the large volumes of water used for irrigation by agriculture, water conservation savings (which can be achieved at a reasonable cost) will often be extremely cost effective compared to the costs of developing additional water supplies.

In addition to the water savings associated with conversion of flood-irrigated citrus to micro-irrigation, IFAS also has indicated that prescriptive applications of water and fertilizer can be made throughout the crop-growing season with micro-irrigation. However, microirrigation systems generally have greater maintenance requirements than flood irrigation systems.

Table 58. Irrigation Costs and Water Use Savings[a] Associated with Conversion from Flood Irrigation to Microirrigation.[b]

Initial cost/acre	$1,000
Operating cost/acre	$25
Water savings (inches/year)	8.519 inches
Water savings (gallons/year)	230,805 gallons
Life	20 years
Cost over life	$1,500
Water savings over life	4,616,100 gallons
Cost/1,000 gallons saved	$0.33

a. Addresses reductions in pumpage only and does not include return flow.
b. Source: IFAS and SFWMD

Estimates of the Quantity of Water Potentially Available from Conservation

Water Conservation Estimates in the Restudy

Estimates of the amount of water that could be saved (or made available) through the use of water conservation practices in the LEC Planning Area were developed as part of the Restudy using a model developed by the Institute of Water Resources (IWR-MAIN) to simulate municipal and industrial use. The model was used to estimate water use to the year 2050, using land use, economic and demographic projections. Projections were made with and without the implementation of conservation practices. The projections without conservation are called Projection A. The only conservation practice they incorporate is the effect of increasing block rate structures. Conservation practices included in Projection B, the conservation projection, are that all new construction would incorporate water-conserving faucets, showerheads and toilets, that local governments would implement ordinances to restrict lawn irrigation to the period from 9 PM to 5 and that irrigation systems would be equipped with rain sensors. All of these efforts represent the continued implementation of existing federal, state and District regulations and programs. The resulting per capita consumptions are presented in **Table 59** The water conservation projections were included in evaluations in the Restudy and were used in formulating Alternative D13R and the recommended plan.

Table 59. Average Per Capita Water Use Resulting From Projections A and B.[a]

Year	Gallons/Capita/Day	
	Projection A	Projection B
2000	226	214
2010	228	207
2030	220	189
2050	215	178

a. Source: USACE, 1999

Results of the IWR Main based conservation analysis as compared to the without conservation analysis are shown in **Table 60.** The percentage reductions in total average use within each service area varies, but for 2020, the percentages would generally range from 12 -13%. This represents an estimate of the potential savings that could result when utilities and local governments enforce existing conservation programs and regulations and especially the installation of water conserving indoor fixtures in all new and replacement installations. These estimates of significant future reductions in per capita use are in contrast to the estimates developed and used in the LEC Plan which are based on utility estimates of demand and population and which show an actual increase in per capita consumption from 1995 to 2020.

Table 60. Reduction in Total Average Use Resulting from Conservation.[a]

Service Area	2000	2010	2030	2050
Northern Palm Beach County	4.96%	9.56%	14.32%	17.37%
LECSA 1	4.53%	8.66%	13.00%	15.76%
LECSA 2	6.18%	10.12%	14.92%	18.12%
LECSA 3	5.01%	9.26%	14.27%	17.71%
Total	5.25%	9.39%	14.16%	17.34%

a. Extent to which conservation water use projection with conservation features in place is lower than the projection of water use without conservation (USACE, 1999).

Water Conservation Conclusions

- Effective water conservation programs can provide a cost-effective means to increase available water supplies.
- Restudy efforts and water utility estimates (used in the LEC Plan) differ as to whether existing water conservation programs and laws will ultimately accomplish a reduction in per capita consumption. Efforts should be undertaken to determine if existing programs and rules are being effectively implemented and whether they are achieving the expected reduction in per capita consumption.
- Efforts should be made to increase awareness of this option and help local governments, utilities and consumers to develop a conservation ethic and implement cost-effective water conservation practices and technologies.
- Water conservation related reduction goals should be established on a user-by-user basis, considering the particular factors and opportunities that characterize the use.

Surficial Aquifer Resources

The surficial aquifers are the major source of water in the LEC Planning Area. The Surficial Aquifer System (SAS) includes two major aquifers in the LEC planning area. The Biscayne aquifer is located within Miami-Dade, Broward, and southern Palm Beach Counties. An undifferentiated surficial aquifer is found in the remainder of Palm Beach County. The entire surficial aquifer system is unconfined, consisting of varying amounts of limestone and sediments from land surface the top of an intermediate confining unit. This intermediate confining unit – consisting of several hundred feet of low-permeability clays and marls – effectively separates the surficial aquifer system from the underlying Floridan Aquifer System (FAS) in much of the planning area. Almost all municipal and irrigation water is obtained from the surficial aquifer system in south Florida.

The second aquifer system, the Floridan Aquifer System, is divided into Upper and the Lower Floridan aquifers by a middle confining layer. North of Lake Okeechobee (e.g., Orlando area), the Floridan aquifer is a source of fresh water. But moving south of Lake Okeechobee and into south Florida, the aquifer deepens and becomes more mineralized. The Upper Floridan Aquifer along the LEC, from Jupiter to south Miami, is comprised of brackish water and in some cases is used as a source of water for reverse osmosis systems and for storage of potable water using aquifer storage and recovery (ASR) technology.

The Lower Floridan Aquifer System is isolated from the Upper Floridan aquifer system by several hundreds of feet of confining units creating isolation between the two systems. The Lower Floridan Aquifer contains a highly transmissive, cavernous zone of limestone locally known as the Boulder Zone. Because this zone contains highly saline water, it is not used as a source of drinking water and is not considered as a potential source of water in this plan.

This section will focus on the aquifer properties characteristic of the LEC planning area, and the current water supply demand and water producing capability of each aquifer.

Surficial Aquifer System Estimated Costs

The costs related to well construction for the Surficial Aquifer System are provided in **Table 61**. There are additional costs for water treatment for potable uses. Many of the treatment facilities in the planning area use lime softening for surficial aquifer water. Lime softening's cost advantages are in operating and maintenance expenses (**Table 62**), where costs are typically 20 percent less than for comparable membrane technologies. However, membrane softening is being used by utilities to enhance or replace traditional lime softening due more stringent water quality standards. The cost of membrane softening is indicated in **Table 63**. One significant advantage over lime softening is membrane softening's effectiveness at removing organics that function as a precursor to the formation of disinfection by-products, such as trihalomethanes.

Table 61. Surficial Aquifer System Well Costs.[a]

Surficial Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	O&M Cost (per 1,000 gallon)	Energy Cost (per 1,000 gallon)
Costs	$45,000	$62,000	$16,000	$.004	$.025

a. Costs based on a 16-inch diameter well and a maximum Surficial well depth of 200 feet; Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 62. Lime Softening Treatment Costs.[a]

Facility Size (MGD)	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (acres)	O&M Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.63	$.25	1.5	$.60	$.023
5	$1.57	$.24	2.5	$.56	$.023
10	$1.53	$.23	4.0	$.50	$.021
15	$1.26	$.19	6.0	$.41	$.020
20	$1.13	$.16	8.0	$.38	$.020

a. Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 63. Membrane Softening Costs.[a]

Facility Size (MGD)	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (acres)	O&M Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.67	$.25	0.40	$.55	$.200
5	$1.52	$.23	0.40	$.53	$.200
10	$1.41	$.21	0.50	$.50	$.200
15	$1.38	$.21	0.63	$.48	$.200
20	$1.33	$.20	0.78	$.46	$.200

a. Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Alter Secondary Canal Operations to Capture, Store and Utilize Additional Local Water

This option includes structural and operational changes that allow capturing of additional runoff water which will be held in the secondary canal systems. A portion of the water captured in the secondary canal systems will come from excess water in the primary canal system, while some will be water captured within the secondary system itself. This option will also foster the utilization of this water by allowing appropriate reductions in water levels before water is obtained from regional sources to replenish water in the secondary canal systems. One objective of this option is to stabilize the salt front by holding higher surface and groundwater levels in coastal areas. Higher groundwater levels will also help in recharging wellfields and frequency of water shortages should decline. Modifying secondary canal operations will improve local water use and recharge, and will help to reduce the need to bring water in from regional sources. If higher water levels will be held, the potential impacts on flood protection must be considered.

This option is currently being implemented as a Water Resource Development Project in Broward County as part of the Interim Plan for Lower East Coast Regional Water Supply (LEC Interim Plan) and this plan recommends continuation and completion of that effort. A similar component is recommended under the CERP to enhance secondary canal delivery capability in central and southeast coastal Broward County.

Aquifer Storage and Recovery – Utility

This option involves the storage of surface water or surficial groundwater in the upper Floridan aquifer during periods of abundant water and recovery of that water during dry periods. Utility ASR systems in most cases involve the storage of treated water. Storage of water takes place during periods of low utility demands when excess treatment capacity is available. Recovery of the stored water takes place during periods of high demands to supplement treatment plant production.

Within the LEC planning area, this option has been in use for several years by the City of Boynton Beach's water utility. In addition, the Miami-Dade Water and Sewer Authority (MDWASD) has constructed several large ASR facilities which operate utilizing untreated groundwater prior to treatment by the water plants. The LEC Interim Plan provides financial support for development of the MDWASD ASR facilities because of their positive impact on the regional water resources of the area.

Surficial Wellfield Development, Relocation or Expansion

This option involves the development of surficial wellfields, an option which is traditionally undertaken when developing or expanding surficial water treatment facilities Locations of surficial water withdrawals are permittable if they meet the reasonable/ beneficial use test and will not cause saltwater intrusion or negatively impact wetlands or adjacent legal water users.

Information provided to the District by water utilities in the LEC planning area, indicate virtually all utilities are planning for additional surficial wellfield expansion. Twenty utilities reported that they expected additional production only from existing wellfields, while five reported that they will be developing wellfield capacity at new locations. In addition, LEC planning efforts have identified a number of opportunities for wellfield relocation. Moving existing demands to new locations could reduce or eliminate potential saltwater intrusion problems during dry periods and greatly increase the ability to access water from the regional canal distribution system

Interconnections with Other Utilities (Water Transfer)

This option makes use of interconnects between water utilities to deliver either raw or treated water from one utility to another. Interconnects are useful in moving raw water from an area with adequate water resources to one where water resources are limited. Utilities may also use treated water interconnections when one utility has inadequate treatment capacity to meet its demands. Forty-five utilities in the LEC planning area have some form of interconnection with other utilities to provide transfer of water.

Secondary Canal Interconnections to Improve Delivery of Regional Water

This option includes the physical facilities that would increase the connectivity among and between the coastal drainage basins and the regional system. These facilities

would be used to increase deliveries of regional water to locations where higher water levels are needed to recharge wellfields and prevent saltwater intrusion.

Lower Elevations of Existing Municipal Intake Structures

This option applies to utilities which obtain their water from Lake Okeechobee and may have difficulty withdrawing water at lowered Lake levels. Lowering the elevations of intake structures will allow the utilities to continue to withdraw water during periods when Lake Okeechobee levels are abnormally low.

The cities of Belle Glade, South Bay, Pahokee, and Okeechobee and Okeelanta water utilities which take water directly from Lake Okeechobee should carefully evaluate the capability of their present water intakes to operated at low Lake levels. The incremental evaluations conducted as a part of this plan indicate that until major storage components in the Lake Okeechobee Service Area come on line, there is a significant possibility of very low Lake levels during severe droughts

Quantity of Water Potentially Available from Surficial Aquifer System

From a regional perspective, increases in production from the Biscayne aquifer along the coast beyond existing demands (XX MGD) appears limited due to potential salt water intrusion. Based on this assessment, it was concluded the Biscayne aquifer is sufficient to meet urban and agriculture demand. Some further development of the aquifer can be accomplished at the local level through modifications to wellfield locations, configurations and pumping regimes, and by increasing storage, such as through the use of reservoirs or aquifer storage and recovery. Developing wellfield configurations and pumping regimes has been successfully used in most consumptive use permitting activities to maximize use of the resource and avoid causing harm to natural systems. As a result, water availability will have to be evaluated on a project-by-project basis in some areas. The volume of water that could be withdrawn by any specific user must be determined through the District’s consumptive use permitting program.

Surficial Aquifer System Conclusions

- The surficial aquifer system, including the Biscayne aquifer, is the primary source of water in the LEC region. Development of new wellfields is anticipated to provide most of the water needed in the future so that perhaps 1200 MGD will be consumed from this source for public water supply by 2020
- This water is generally of excellent quality, wells have excellent yields and treatment costs are low.
- In some areas, withdrawals from the surficial aquifer are periodically threatened by saltwater intrusion and there is limited or no access to water from the regional system. In areas where yields are limited by low production rates, aquifer contamination or saltwater intrusion, alternative sources may be considered,

including the need to relocate wellfields to safer and more productive locations.

Floridan Aquifer System

Definition and Discussion

The Floridan Aquifer System (FAS) underlies all of Florida and portions of southern Georgia and Alabama. It is the principal source of water in Central Florida; however, the FAS yields only nonpotable water throughout most of the LEC planning area. The quality of water in the FAS deteriorates southward, increasing in hardness and salinity. With depth, the salinity increases, making the deeper producing zones less suitable for the water supply development than the shallower zones near the top of the aquifer. Within the Planning Area, the FAS is not influenced by variations in rainfall.

Water from the shallow zones must be treated by desalination to produce a potable product. The most productive zones in the FAS are the lower Hawthorn and Suwannee aquifers. Several utilities in the planning area are considering use of water from the FAS to meet their needs Elsewhere in the planning area, these aquifers supply only a few agricultural irrigation wells. With continued growth and development in the LEC planning area, these aquifers may become a significant source of water to meet the demand. Although desalination of the water will be necessary for potable use, blending of the raw water with higher quality water could produce a product suitable for irrigation purposes.

In the deeper zone of the FAS, areas of extremely high transmissivity exist, termed “boulder zones”. These zones are not used for supply sources within the planning area due to high salinity and mineral content of the water. However, treated wastewater effluent and concentrate or residual brines from the desalination process are injected into this zone as a means of disposal. In addition, zones within the upper portion of the FAS are also used for aquifer storage and recovery (ASR). Utilities in Dade and Palm Beach counties are currently testing the feasibility of ASR (see ASR later in this Chapter for additional information).

Within the LEC Planning Area, there is limited information, data, and experience regarding the use of the FAS. Some utilities are considering the use of the FAS to meet existing and future demands. There is a concern for water quality and the long-term sustainability of the FAS. However, based on limited information and experience with the FAS, significant changes in water quality are not anticipated. Consideration of development of a comprehensive FAS ground water model for Dade, Broward and Palm Beach counties to be used for predictive analysis in the future by the District is recommended. Currently, some local FAS models are being used. However, these model have very limited capabilities based on the limited hydraulic information.

Currently, utilities are drilling into the FAS in the LEC Planning Area for water supply and wastewater disposal. The District should work in conjunction with water users/ utilities to gain water quality and hydraulic information during the scope of work

development related to FAS well drilling programs. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs) and aquifer performance testing. In most cases, these activities would be nominal compared to the actual well drilling cost. The District should consider budgeting for these items and cost-share for additional testing and data acquisition. It is also recommended that a FAS monitoring network be established to collect the data necessary to establish the relationship between water use, water levels, and water quality.

Floridan Aquifer System Estimated Costs

The costs related to wellfield development of the FAS are provided in **Table 64**. For potable water use, there are additional costs for desalination treatment, such as reverse osmosis (**Table 65**) and concentrate disposal (**Table 66)**. Site-specific costs associated with reverse osmosis (RO) can vary significantly as a result of source water quality, concentrate disposal requirements, land costs, and use of existing water treatment plant infrastructure. As a general rule, RO costs are 10 to 50 percent higher than lime softening depending on the water quality of the source water. For brackish water with total dissolved solids up to 10,000 mg/L, electrodialysis and electrodialysis reversal are generally effective, but cost about 5 to 10 percent higher than RO treatment (Boyle Engineering, 1989).

Table 64. Floridan Aquifer System Well Costs.[a]

Floridan Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	O&M Cost (per 1,000 gallon)	Energy Cost (per 1,000 gallon)
Costs	$115,000	$65,000	$18,000	$.004	$.040

a. Costs based on a 16-inch diameter well and a maximum Floridan well depth of 900 feet; Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 65. Reverse Osmosis Treatment Costs.[a]

Facility Size (MGD)	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (acres)	O&M Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.76	$.26	.40	$.58	$.29
5	$1.59	$.24	.40	$.54	$.29
10	$1.47	$.23	.50	$.51	$.29
15	$1.43	$.21	.63	$.50	$.29
20	$1.46	$.20	.78	$.38	$.29

a. Costs based on 2,000 mg/L TDS, 400 PSI; Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Recent improvements in low pressure membranes has reduced the electrical costs associated with RO systems. Because RO pump power consumption is directly

Table 66. Concentrate Disposal Costs.[a]

Deep Well Disposal Facility (MGD)	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (acres)	O&M Cost (per 1,000 gallons)
3	$.73	$.109	0.5	$.040
5	$.55	$.083	0.5	$.030
10	$.50	$.075	1.0	$.028
15	$.46	$.070	2.0	$.025
20	$.38	$.056	3.0	$.020

a. Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

proportional to pressure, the low pressure systems can provide significant reductions in power consumption. The RO treatment cost presented herein do not reflect the recent improvements in membrane technology.

Floridan Aquifer Blending

Under this option water utilities would blend brackish water from the Floridan Aquifer system with Biscayne or surficial freshwater they have withdrawn. Sodium concentration and other quality considerations would limit the amount of Floridan water used in blending. The Floridan Aquifer System in the Lower East Coast study area is a brackish aquifer that lies below the Biscayne aquifer and is separated from the Biscayne by approximately 700 feet of low permeability sediments. The ground water of the Floridan aquifer system is independent of the Lower East Coast region's surface water and surficial aquifer system. The Upper Floridan is preferred as a potential source of water for blending given its relatively low salinity.

Brackish Water Desalination

Under this option, water utilities would use reverse osmosis or other appropriate treatment process (electrodialysis or ion exchange) to recover fresh water that meets drinking water standards from the brackish water of the Floridan Aquifer System that underlies the Lower East Coast study area. The Floridan Aquifer lies below the Biscayne aquifer and is separated from the Biscayne by approximately 700 feet of low permeability sediments. The ground water of the deeper Floridan aquifer system is independent of the Lower East Coast region's surface water and surficial aquifer system. The Upper Floridan is preferred as a potential source for reverse osmosis treatment because of its relatively low salinity levels. Reverse osmosis and distillation take the water out of the salt solution. Electrodialysis and ion exchange take the salt out of the salt solution. Reverse Osmosis is presently being used by a number of utilities in the LEC and may become more common as it provides as provides a very good water that helps utilities meet drinking water standards that are sometime difficult to meet using conventional treatment technologies.

Quantity of Water Potentially Available from the Floridan Aquifer

Several utilities have recently considered use of the FAS. There is limited information, data, and experience regarding the use of the FAS aquifer in the LEC Planning Area. Regional FAS ground water models do not exist in the LEC Planning Area. This assessment did not incorporate a water quality component nor does sufficient data exist to conduct such an analysis. However, based on the limited data, knowledge, and experience in the LEC Planning Area, as well as FAS experience in other areas, it was concluded that the FAS could support all of the existing and projected demands for the potable water utilities without causing significant changes in water quality in the FAS. As stated previously, development of a FAS ground water model and monitoring program are recommended for conducting predictive analyses in the future.

Floridan Aquifer System Conclusions

- The FAS has the potential to yield large quantities of water for potable use. The exact quantities are unknown at this time
- Within the LEC planning Area, the FAS is not influenced by variations in rainfall and could be considered “drought proofed.”
- Treatment costs are moderate and are declining as technology improves.
- Local water users could consider using the FAS as an alternative or supplemental source of water to reduce demands on conventional fresh water sources during dry periods.
- Any efforts to conduct FAS well drilling programs in the LEC region should be coordinated to facilitate collection of FAS water quality and hydraulic information.

Reclaimed Water

Definition and Discussion

This section uses the following definitions of terms:

- Reclaimed water is water that is reused for a beneficial purpose after flowing out of a wastewater treatment facility.
- Reuse is the deliberate application of reclaimed water for a beneficial purpose.
- Treatment Plant Capacity - The permitted capacity or maximum amount of wastewater that a WWTP can treat.
- Treatment Plant Flow - The average annual flow or amount of wastewater that actually flows through a WWTP.

- Reuse Capacity - The permitted capacity or maximum amount of reclaimed water that a reuse system can accommodate or distribute.
- Reuse Flow - The average annual flow or amount of reclaimed water actually being allocated or distributed to a reuse system or activity.

In 1997, wastewater facilities in Broward, Dade, Monroe and Palm Beach Counties treated an average of 673 MGD of wastewater, of which 48 MGD (about 7%) was reused. The treatment capacities and flows for facilities that provided reuse water during 1997 area listed in **Table 67.** Wastewater reuse takes place when treated wastewater which would otherwise be disposed of in a way that represents a loss to the freshwater system is instead reapplied to that system. The reclaimed water may directly substitute for an existing use or it may indirectly make more water available for use by increasing the recharge of ground or surface waters. The benefits include enhancement to the water supply by the introduction of a new source that can help meet projected nonpotable demands. Reuse included irrigation of golf courses, residential lots, medians, and other green space and ground water recharge via percolation ponds.

Reclaimed water plays a significant role in meeting the needs of this region and this is expected to increase in the future. The amount of water reused by each utility and the type of reuse are shown in **Table 68.** Some options for use of reclaimed water at a regional scale were mentioned previously under the description of CERP Projects. In addition, many jurisdictions or utilities in the Lower East Coast presently used reclaimed water in a variety of ways, and additional applications are being investigated.

Potential uses of reclaimed water include landscape and agricultural irrigation, ground water recharge, industrial uses and environmental enhancement. The ground water modeling associated with this plan found the existing and projected use of reclaimed water in the coastal portions of the planning area to reduce demands on the aquifer was very helped reduce potential exceedances of wetland protection and seawater intrusion criteria. The volume of reclaimed water that is reused is projected to increase as wastewater flows increase due to development, and as current/proposed reuse programs are implemented. In addition to supporting continuation of implementation of the utility plans, several options to increase the effectiveness and efficiency of these programs, especially during low rainfall periods, are discussed.

In addition to using reclaimed water for irrigation, reclaimed water has potential use the as a saltwater intrusion barrier. For the Biscayne aquifer, this use could possibly be accomplished by applying reclaimed water at land surface through percolation ponds or trenches along the coast, or by discharge to coastal canals, thereby creating a freshwater mound that would impede the movement of salt water inland. Alternatively, a series of injection wells could be constructed along the coast to accomplish the same result. However, compliance with federal and state underground injection requirements would have to be negotiated.

Table 67. Domestic Wastewater Treatment Facilities Providing Reuse.

Facility Name	WAFR ID	Capacity (MGD)	Flow (MGD)
Palm Beach County			
A Garden Walk	FLA013735	0.10	0.08
Belle Glade WWTP	FLA027740	3.00	2.70
Bryant Village/US Sugar Corp.	FLA013704	0.17	0.07
City Of Boca Raton WWTP	FL0026344	17.50	13.89
East Central Regional WWTF	FLA013674	55.00	40.00
Loxahatchee Environmental Control District	FL0034649	8.00	4.96
Okeelanta Corporation	FLA013706	0.23	0.03
Palm Beach County Southern Regional Facility	FLA041424	30.00	18.81
Royal Palm Beach Village WWTF	FLA013749	2.20	1.73
Seacoast Utilities PGA	FL0038768	8.00	6.55
South Central Regional WWTF	FL0035980	24.00	16.50
Palm Beach County Total		148.20	105.32
Broward County			
Broward County North Regional	FL0031771	80.00	65.95
City Of Hollywood	FL0026255	42.00	35.00
City Of Sunrise SW WWTF	FLA013580	0.99	0.48
Plantation Regional WWTP	FL0040401	15.00	12.58
Pompano Beach	FLA013581	2.50	1.35
Broward County Total		140.49	115.36
Miami-Dade County			
Homestead	FLA013609	2.25	2.25
Krome Service Processing Center	FLA013605	2.25	2.47
MDWASD Southern District WWTF	FL0042137	88.73	85.14
Miami-Dade Central District WWTF	FLA024805	150.84	132.24
Miami-Dade Northern District WWTP	FL0032182	116.94	98.77
Miami-Dade County Total		361.01	320.87
Monroe County			
Duck Key WWTF	FLA014772	0.10	0.10
Key West Resort Utility	FLA014951	0.50	0.19
Monroe County Total		0.60	0.29
LEC Planning Area Total		**650.30**	**541.84**

Table 68. Reclaimed Water Utilization.

Reuse System Name	Reuse Type[a]	Reuse SubType[b]	Capacity (MGD)	Flow (MGD)	Area (acres)
Palm Beach County					
A Garden Walk	GWR&IPR	RIB	0.08	0.08	6
Belle Glade WWTP	GWR&IPR	RIB	0.07	1.23	7
Boca Raton (Project Iris)	PAA&LI	OPAA	2.10	0.75	
Boca Raton (Project Iris)	PAA&LI	RI	8.00	0.68	
Boca Raton (Project Iris)	PAA&LI	GCI	2.90	0.51	
Boca Raton (Project Iris)	IND	ATP	0.90	0.90	
East Central Regional WWTP	WL	NA	0.15	0.03	2
Loxahatchee Environmental Control District	IND	ATP	1.00	0.46	
Loxahatchee Environmental Control District	PAA&LI	RI	0.10	0.07	43
Loxahatchee Environmental Control District	PAA&LI	GCI	5.66	3.18	1300
Loxahatchee Environmental Control District	PAA&LI	OPAA	0.70	0.59	130
Okeelanta Corporation	GWR&IPR	RIB	0.23	0.03	3
Palm Beach County Southern Regional	PAA&LI	RI	1.32	1.32	
Palm Beach County Southern Regional	PAA&LI	GCI	0.84	0.84	
Palm Beach County Southern Regional	IND	ATP	3.70	3.70	
Palm Beach County Southern Regional	WL	NA	3.00	1.45	
Royal Palm Beach Village Utilities	GWR&IPR	RIB	1.24	0.76	20
Seacoast Utilities PGA	PAA&LI	OPAA	0.00	0.05	24
Seacoast Utilities PGA	PAA&LI	RI	0.00	0.18	63
Seacoast Utilities PGA	PAA&LI	GCI	8.00	2.10	1531
South Central Regional WWTP	IND	ATP	1.80		
South Central Regional WWTP	PAA&LI	GCI	0.57	1078	
U.S. Sugar Corp Bryant Village	GWR&IPR	RIB	0.17	0.07	
Palm Beach County Total			40.16	21.34	4206
Broward County					
Broward County North Regional	IND	AOF	1.31	1.31	
Broward County North Regional	IND	ATP	3.29	3.29	
Broward County North Regional	PAA&LI	OPAA	1.74	1.74	30
City of Sunrise (South Broward)	GWR&IPR	RIB	1.00	0.48	5
Hollywood	PAA&LI	GCI	4.00	2.82	753
Plantation Regional	IND	ATP	2.16	0.73	
Pompano Beach	PAA&LI	GCI	2.05	1.10	323
Pompano Beach	PAA&LI	OPAA	0.45	0.25	76
Broward County Total			16.01	11.73	1188
Miami-Dade County					
Homestead	GWR&IPR	RIB	2.25	2.25	14
Krome Service Processing Center	GWR&IPR	AF	2.25	2.47	
MDWASA Central District WWTF	IND	ATP	7.84	4.24	
MDWASD N District WWTP	PAA&LI	OPAA	1.50	0.06	40
MDWASD N District WWTP	IND	ATP	2.94	2.70	
MDWASD South District WWTF	IND	ATP	3.73	3.40	
Miami-Dade County Total			20.51	15.12	54

Table 68. Reclaimed Water Utilization.

Reuse System Name	Reuse Type[a]	Reuse SubType[b]	Capacity (MGD)	Flow (MGD)	Area (acres)
Monroe County					
Duck Key Wastewater Cooperative	PAA&LI	OPAA	0.10	0.05	20
Key West Resort Utility	PAA&LI	GCI	0.50	0.19	60
Monroe County Total			0.60	0.24	80
LEC Planning Area Total			**227.28**	**48.43**	**5528**

a. Reuse Types: PAA&LI - Public Access Areas and Landscape Irrigation; AI - Agricultural Irrigation; GWR&IPR - Ground Water Recharge and Indirect Potable Reuse; IND - Industrial; TF - Toilet Flushing; FP - Fire Protection; WL - Wetlands; OTH - Other

b. Reuse Subtypes; GCI - Golf Course Irrigation; RI - Residential Irrigation; OPAA - Other Public Access Areas; EC - Edible Crops; OC - Other Crops; RIB - Rapid Infiltration Basins; AF - Absorption Fields; SWA - Surface Water Augmentation; INJ - Injection; ATP - At Treatment Plant; AOF - At Other Facilities

Reclaimed Water Estimated Costs

The costs associated with implementation of a reclaimed water program can vary significantly depending on the type of reuse system (i.e., ground water recharge, public access irrigation, etc.), the capacity of the reclamation facility, treatment components, the extent of the reclaimed water distribution system, and the regulatory requirements. Cost savings include negating the need for or reducing the use of alternative disposal systems, reducing the demand on ground water systems, and reducing the volume of potable water used for irrigation.

For a reuse system that utilizes reclaimed water for public access irrigation, utility representatives indicated infrastructure cost would be approximately $1.00 per 1000 gallons, while the operation and maintenance of the system would be around $0.21 per 1000 gallons. For public access irrigation systems using reclaimed water, the infrastructure cost would include the costs associated with construction of advanced secondary treatment components including filtration, high level disinfection facilities, online continuous water quality monitoring equipment, storage facilities, pumps, and transmission and distribution piping. Operation and maintenance costs would include chemical, pumping and maintenance for the treatment and distribution system.

Quantity of Water Potentially Available from Reclaimed Water

Table 69 indicates current wastewater facilities that are reusing wastewater have a reuse capacity of 227 MGD and a current reuse flow of 48 MGD. Hence, a capacity for development of 180 MGD presently exists within the region. Water use within the region was about 784 MGD in 1995 and is projected to increase to 1213 MGD by 2020, which is an increase of about 55%. If wastewater flow increases proportionally, this corresponds to about 1050 MGD of wastewater flow. If the proportion of wastewater is reused remains the same, this translates to about 70 MGD. Present Reuse capacity is about 34% of total wastewater flow. If this proportion remains the same in the future, wastewater treatment would represent a capacity of about 357 MGD by 2020.

Table 69. Disposal Facilities[a] with No Reuse

Domestic WWTF Name	Facility ID	Capacity (MGD)	Flow (MGD)
Palm Beach County			
Acme Improvement District	FLA042595	3.00	2.40
East Central Regional WWTP	FL0041360	55.00	40.00
Pahokee WWTP	FLA136778	1.20	1.08
Pratt and Whitney	FLA013693	0.22	0.09
South Bay WWTP	FLA021300	1.42	0.78
Palm Beach County Total		60.84	44.35
Broward County			
City of Margate East Plant	FL0169617	2.20	0.00
City of Margate WWTP	FL0041289	8.00	8.23
City of Miramar WWTF	FLA017025	8.90	0.00
City of Pembroke Pines	FLA013575	7.69	4.22
Cooper City West WWTP	FL0040398	2.50	2.90
Coral Springs Improvement District WWTF	FLA041301	5.50	5.00
Ferncrest	FLA013583	0.60	0.30
Fort Lauderdale - G.T. Lohmeyer	FL0041378	43.00	38.31
Sunrise No. 1 WWTF	FLA041947	9.00	7.07
Sunrise No. 2 WWTP	FLA042633	3.00	1.81
Sunrise No. 3 WWTP	FLA042641	13.75	9.05
Town Of Davie WWTP	FL0040541	3.00	2.28
Broward County Total		107.14	79.17
Miami-Dade County			
American Village MHP	FLA013641	0.20	0.13
Cricket Club, The	FLA013637	0.10	0.07
Miami-Dade County Total		0.30	0.20
Monroe County			
Key Haven Utility	FLA014867	0.20	0.19
North Key Largo WWTP.	FLA015009	0.55	0.29
Richard A. Heyman WWTP -Key	FL0025976	7.20	7.20
Monroe County Total		7.95	7.68
LEC Planning Area Total		**176.23**	**131.40**

a. Domestic Wastewater Treatment Facilities

The potential need in the future to integrate water conservation and reclaimed water systems has been considered. The concept is that reuse systems should be designed to apply reclaimed water to meet the needs of the plants and provide aquifer recharge, rather than as a system to make this water inaccessible.

Reclaimed Water Conclusions

- Only about 28 MGD of reclaimed water is used in the LEC region today, although the existing reuse capacity is about 220 MGD.
- Reclaimed water has potential use to help meet irrigation demands and to enhance regional resources, including wetlands and aquifer systems and to help meet the freshwater flow requirements of estuaries.
- If current trends continue, reuse capacity in the region could increase to 350 MGD by 2020.
- Supplemental sources and interconnection with other utilities may provide an effective means to improve the volume of reclaimed water reused.
- The cost of using reclaimed water for irrigation greatly exceeds the cost of available conventional supplies. However, in areas where conventional supplies are not available, reclaimed water use is cost-effective.
- Large-scale reclaimed water projects involving environmental hydropattern enhancement and/or aquifer recharge have regulatory issues which need to be carefully addressed for such projects to be cost-effective.

Seawater Desalination

Definition and Discussion

This option involves using seawater from the Atlantic Ocean as a raw water source. The Atlantic Ocean appears to be an unlimited source of water from a quantity perspective; however, removal of the salts is required before use for potable or irrigation uses. A desalination treatment technology would have to be used, such as distillation, reverse osmosis, or electrodialysis reversal (EDR).

Seawater Estimated Costs

The cost of desalination of seawater is estimated to be significant, up to eight times the cost of reverse osmosis of the FAS. In addition, reverse osmosis and EDR facilities treating seawater would be expected to have an efficiency of 25 percent, resulting in increased concentrate/reject water disposal needs compared to desalination of the brackish water of the Upper Floridan aquifer.

Tampa Bay Water, located in the Southwest Florida Water Management District, is moving ahead to construct a seawater desalination treatment facility initially capable of producing 25 MGD of drinking water with estimated first year costs as low as $1.71-per-thousand-gallons, significantly lower than originally assumed and significantly below the

costs for water at similar plants under construction elsewhere. For example, in Singapore, a 36 MGD desalination plant is estimated to cost between $7.52 and $8.77 per thousand gallons.

Some of the factors reducing the cost of this facility include co-locating the water treatment plant with a power plant, using the power plant's existing cooling water discharge system for concentrate disposal, and using the power plant's existing facilities for the intake to the water treatment plant. The SFWMD is in the process of soliciting proposals to conduct a feasibility study of co-locating seawater reverse osmosis water treatment facilities with coastal electrical power plants in the District's area of jurisdiction.

Seawater Desalination Conclusions

- Seawater Desalination can provide an unlimited amount of high quality for potable use.
- The costs of seawater desalination are generally high, depending on the quality of source water, due primarily to high energy costs associated with reverse osmosis (RO). These costs are declining as RO technology improves
- Utilities considering seawater desalination should consider coordinating with the District and other agencies to examine the need for this alternative, current trends in technology and options to combine this approach with other methods

Aquifer Storage and Recovery

Definition and Discussion. Aquifer Storage and Recovery (ASR) can be treated as either a regional water resource project or as a local water supply option, depending on the project location, scale and population served. Regional scale applications of this technology were discussed previously. The following information provides general information that may be useful for planning efforts by local utilities.

Aquifer storage and recovery (ASR) is the underground storage of high quality water in an acceptable aquifer through a well (typically the Upper Floridan Aquifer in the LEC planning area during times when water is available, and the subsequent recovery of that water from that same well during high demand periods. In other words, the aquifer acts as an underground reservoir for the injected water, reducing water loss due to evaporation.

Current regulations require injected water to meet drinking water standards when the receiving aquifer is classified as an Underground Source of Drinking Water (USDW) aquifer, unless an aquifer exemption is obtained from the U.S. Environmental Protection Agency (EPA). Obtaining an aquifer exemption is a rigorous process and few have been approved. However, the EPA has indicated a willingness to utilize a more flexible permitting approach for proposed ASR systems meet all drinking water standards with the

exception of coliform bacteria. This additional flexibility should assist in permitting raw water ASR facilities in the LEC planning area.

Treated Water ASR . Treated water ASR involves using potable water as the injection water. Since potable water meets the drinking water standards, this type of ASR application is more easily permitted. There are many examples in Florida, including several in the LEC Planning Area, of utilities using treated water ASR. These include the city of Boynton Beach ASR facility which has been in successful operation for several years.

Raw Water ASR . The development of raw water as a source for ASR systems is underway by some utilities in the LEC Planning Area. The Miami-Dade Water and Sewer Authority has constructed several ASR wells in their wellfields, which will store untreated surficial water until needed by the system's water treatment facilities. Currently, there are no operating untreated surface water ASR projects in Florida.

Reclaimed Water ASR . Reclaimed water ASR would involve using reclaimed water as the injection water. Currently, there are no operating, reclaimed water ASR projects in Florida. Several communities in Florida are interested in reclaimed water ASR and are investigating the feasibility of such a system.

Aquifer Storage and Recovery Estimated Costs

Estimated costs for an ASR system largely depend on whether the system requires pumping equipment (**Table 70**). In the table, one system uses pressurized water from a utility; whereas the second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost. (Refer to the Support Document for cost assumptions). The latter system with its associated pumping costs is more indicative of an ASR system in combination with surface water storage. There may also be additional costs for screening and filtering untreated surface water to remove floating and suspended matter.

Table 70. Aquifer Storage and Recovery System Costs[a]

System	Cost				
	Well Drilling (per well)	Equipment (per well)	Engineering (per well)	O&M (per 1,000 gallon)	Energy (per 1,000 gallon)
Treated Water at System Pressure	$250,000	$40,000	$450,000	$.005	$.08
Treated Water Requiring Pumping	$250,000	$125,000	$500,000	$.008	$.08

a. Costs based on a 900-foot, 16-inch well, with two monitoring wells using treated water; Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Quantity of Water Potentially Available from Aquifer Storage and Recovery

The volume of water that could be made available through ASR wells depends upon several local factors, such as well yield, water availability, variability in water supply, and variability in demand. Without additional information, it is not possible to accurately estimate the water that could be available through ASR in the LEC Region. Typical storage volumes for individual wells range from 10 to 500 million gallons (31 to 1,535 acre-feet). (Pyne, 1995) Where appropriate, multiple ASR wells could be operated as a wellfield, with the capacity determined from the recharge and/or recovery periods. There are potentially many different applications of ASR; however, all store sufficient volumes (adequate volumes to meet the desired need) during times when water is available and recover it from the same well(s) when needed. The storage time is usually seasonal, but can also be diurnal, long-term or for emergencies. The volume of water that could be made available by any specific user must be determined through the District's consumptive use permitting program.

Reservoirs

Construction of reservoirs can also be treated as either a regional water resource project or as a local water supply option, depending on the project location, scale and population served. Regional scale applications of this technology were discussed previously. The following information provides general information that may be useful for planning efforts by local utilities.

Definition and Discussion

This option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the St. Lucie or Caloosahatchee Estuaries during rainy periods and meet minimum flows during drier periods. Similar facilities could also be used in the Everglades Agricultural Area to regulate the flow of water south into the Everglades. Such facilities, on a smaller scale could increase surface water availability for current and projected uses, and decrease the demand on aquifer systems. However, evaporative and seepage losses could significantly affect water availability and need to considered.

Strategically located surface water storage (primarily storage in combination with improved storm water management systems) could recharge SAS wellfields, reduce the potential for saltwater intrusion, and reduce drawdowns under wetlands. on-site storage in agricultural areas may reduce the need for water from the regional canal system and withdrawals from other water source options. Storm water reservoirs could be located with ASR facilities, and provide a water source for the facility.

Reservoir Estimated Costs

Costs associated with surface water storage vary depending on site-specific conditions of each reservoir. A site located near an existing waterway will increase the flexibility of design and management and reduce costs associated with water transmission infrastructure. Another factor related to cost would be the existing elevation of the site. Lower site elevations would allow for maximum storage for the facility while reducing costs associated with water transmission and construction excavation. Depth of the reservoir will have a large impact on the costs associated with construction. Deeper reservoirs result in higher levee elevations that can significantly increase construction costs.

Costs associated with two types of reservoirs are depicted in **Table 71.** The first is a minor facility with pumping inflow structures and levees designed to handle a maximum water depth of four feet. It also has internal levees and infrastructure to control internal flows and discharges. The second type shown below is a major facility with similar infrastructure as the minor facility. The water design depths for this facility range from 10 to 12 feet. Costs increase significantly for construction of higher levees but can be offset somewhat by the reduced land requirements.

Table 71. Reservoir Costs.

Reservoir Type	Cost ($/acre)				
	Construction	Engineering/ Design	Construction Administration	Land	Operations and Maintenance
Minor Reservoir	2,842	402	318	3,000 - 6,000	118
Major Reservoir	7,980	904	451	3,000 - 6,000	105

Minor reservoir costs are based on actual construction bid estimates received and awarded for similar projects built in the Everglades Agricultural Area (EAA). Costs of these four Stormwater Treatment Areas (STAs) were averaged to develop the $/acre costs. Land costs have been changed to generally reflect land values in the Lower West Coast Planning Area ($3,000 for undeveloped/fallow land, $6,000 for land in citrus production). Major reservoir costs were developed based on the average cost estimates from the proposed Ten Mile Creek project in St. Lucie County and from the Regional Attenuation Facility Task Force Final Report, April 30, 1997 estimates for major Water Preserve Areas on the east coast.

Quantity of Water Potentially Available from Reservoirs

Reservoirs are considered more of a management option in that these systems allow more efficient use of other sources, such as surface water. Please refer to other source option descriptions for an estimate regarding the quantity of water that potentially could be made available.

Conclusions

- Storage is used to provide carryover capacity so that excess water that falls on South Florida during the rainy season can be later used to meet water demands during the dry season
- The primary options are underground (Aquifer Storage and Retrieval{ASR}) and above ground (reservoir) facilities. Both options have significant costs for capital facilities. Exact costs and yields for these systems depend on site-specific conditions.
- ASR has the advantage of providing (at least theoretically) a larger proportion of carryover storage capacity from one year to the next. They have the disadvantage of only being able to handle a limited volume of flow.
- Surface water reservoirs can handle larger volumes of flow but lose water over time to seepage and evaporation.
- Combined systems that use ASR for long term storage combined with reservoirs to capture large volume flows during storm events, provide maximum flexibility

Surface Water

Definition and Discussion

This option involves the use of surface water as a supply source. Surface water bodies in the LEC Planning Area include lakes, rivers, and canals. Lake Okeechobee is the largest lake within the Planning Area, and a primary source of water supply throughout South Florida, including the direct use by local utilities surrounding the lake and as a reservoir to supply the LEC region. Surface water is also used by the City of West Palm Beach, through a system of lakes and wetlands that ultimately connects to the L-8 Canal and Lake Okeechobee. Surface water from the Lake Okeechobee and the Water Conservation Areas can be transported via the regional canal system to provide recharge for local wellfields.

No additional potential natural sources of surface water were identified in the region that should be considered to meet future demands. The LEC Planning Area has been impacted significantly by development of land for agricultural and urban uses. This development has changed the volume and timing of surface water runoff and had negative impacts on estuarine systems. This excess runoff is being evaluated throughout the Planning Area as an opportunity for environmental protection and water supply to work hand in hand -- increasing water availability to meet current and future needs by capturing excess surface water that would otherwise harm Florida's costal resources.

In the future, extensive construction of reservoirs and manmade lakes has been proposed within the region in conjunction with the Everglades Construction Project, the Comprehensive Everglades restoration Plan (CERP) and the Water Preserve Areas

feasibility study. All of these systems have some potential capability to provide water supply benefits that will be evaluated and optimized during their design and construction. In addition, opportunities may exist for local governments and private interest to create surface water impoundments or reservoirs to meet localized water needs.

Other Potential Surface Water Sources

Another potential use for surface water systems in the LEC region is to provide supplemental sources to reclaimed water systems, when water is available, and as potential sources to capture and store (primarily through ASR) excess surface water during the wet season for use during the dry season.

Several considerations need to be addressed in evaluating surface water availability, including seasonal fluctuations, environmental needs both upstream and downstream, storage options, restoration efforts and treatment costs. Several restoration projects are underway or proposed in the region that use natural or artificial lakes or wetlands as components of local water supply and treatment systems, or that use treated wastewater to supplement natural water flows.

Surface Water Conclusions

- No suitable natural surface water sources for water supply development have been identified in the region
- Minimum flows and levels are being developed that will greatly affect the amount and timing of water deliveries that can be obtained from natural systems.
- In the future, regional surface water man-made lakes, impoundments and reservoirs may be constructed. The water supply capabilities of such systems will be evaluated in the process of their design and construction.
- Construction of smaller facilities may also be appropriate to meet localized needs
- The following water supply development recommendations were made regarding Surface Water:
- Utilities should consider using excess surface water as a means to supplement existing reclaimed water sources and maximize reclaimed water use.

CONCLUSIONS

The assessments presented in Chapter 4 indicated that the proposed water resource development projects included in the alternatives, along with appropriate water supply development and operational assumptions would provide the target 1-in-10 level of service. In Chapter 5 the water resource development projects are further identified and

described. It is these projects which will be recommended in Chapter 6. Additional information on a large set of water supply options is also provided. Water users can select from the among the permittable implementations of these options in determining their preferred water supply development actions.

The water resource development projects include, first of all, projects initiated in the Interim Plan for Lower East Coast Regional Water Supply which need to be completed. In addition there are several projects which were developed based on the sub-regional integrated water supply planning processes undertaken as part of the Interim Plan implementation.

A second set of water resource development projects includes other federal, state or district projects. Two of these are “critical projects” which are being implemented in partnership with the federal government. Two are projects proposed in the Caloosahatchee Water Management Plan to address uncontrolled flows from abandoned wells and salt-water problems in the Caloosahatchee River. A specific water conservation effort, mobile irrigation labs, suitable for implementation regionwide is also included.

The third set of water resource development projects, includes the Comprehensive Everglades Restoration Project which forms the backbone of the water resource development included as part of the LEC Plan.

A fourth group, rather than being projects, is a set of recommendations providing guidance to in the CERP program regarding directions and approaches that should be included in the planning and design of CERP projects.

The fifth group of water resource development components includes projects to revise consumptive use permitting, provide for reservations of water, develop minimum flows and levels (MFLs) and specify MFL prevention and recovery strategies as needed to meet legislative requirement and support the implementation of the LEC Plan.

The sixth group includes recommendations regarding the operation of the C&SF system. The focus is on improvements to the water shortage policies and supply-side management that can reduce the impacts of droughts on water users without compromising performance in meeting environmental goals. These recommendations are particularly important given the difficulties expected in meeting water supply performance goals until structural improvements included in the plan begin coming on line after 2005. These difficulties are evidenced by the results of the incremental runs.

The final group of water resource development components includes four projects which will provide key information to support the additional planning that will be undertaken for the 2025 LEC Plan. The first project will evaluate the success of existing conservation programs, requirements and regulations as well as further promote implementation of conservation opportunities. The other three projects which will provide key information regarding the feasibility of additional innovative reuse systems and saltwater reverse osmosis systems and their potential role in further water resource development.

Water supply development options presented in the second major subsection of this chapter should serve as a menu that local water users can consider in determining their preferred water supply development actions. Information is provided on water supply development options that utilize conservation, surficial aquifer resources, the Floridan aquifer system, reclaimed water, seawater desalination, storage and surface water.